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[See page 274.]

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Newspaper Heroism

THE true professional spirit is essentially modest, and among the highest type of professional men the good of the cause ranks higher than the gain of the individual. Pride of place and a laudable ambition to excel go side by side with a settled dislike of limelight exploitation and any form of newspaper notoriety. The ethical distinction between the trades and professions, which was so strongly accentuated in earlier days, and survives in certain parts of the world ever to-day, was based originally upon the fact that the professional man was supposed to take up his life's work primarily because he loved both his profession and the people whom it might benefit. The personal gain which it brought was a secondary consideration. In this respect he was distinguished from the man of commerce, who bought and sold first and last for pecuniary gain. This ethical distinction or dividing line between the trades and professions has largely disappeared; and we are sufficiently optimistic to believe that it has been due to a filtration of the professional spirit into the commercial world.

A case in point occurred on the steamship "Carmania" when she recently put into Halifax for coal, and took advantage of the opportunity to make some minor repairs to her low-pressure turbine. A small leakage pipe, leading from the turbine to the condenser, had developed signs of weakness, and it became necessary to close certain gates which were inaccessible from the exterior of the engine. Ordinarily the turbines would have been allowed to cool down for repairs of this character, but in order to save from six to eight hours' time, which would be necessary for cooling off, the engineers decided to take off the manholes and send one of their number in to close the gates. This was done, and although the internal temperature was about 175 degrees, the task was successfully accomplished.

Upon the arrival of the ship in New York the event was seized upon by the daily press reporter, and a repair job which was designated by the engineers themselves a mere matter of routine duty, was magnified into a story of stupendous heroism and magnificent devotion to duty which, although it may have provided an interesting quarter of an hour for the average citizen over his morning cup of coffee, served only to provoke mingled consternation and ridicule among the engine room's staff of the ship itself. Although a temperature of 175 degrees is scarcely that in which the average individual would choose to take even moderate exercise, it is a fact that in some engine rooms, especially in the tropics, temperatures have been known to run up not so very far from that given. On certain warships, when the hatches are battened down for battle practice, engine-room temperatures have been known to run up as high as 165 degrees.

A Safety Throttle for Locomotives.

PROMPTED by the too frequent instances of the disablement of locomotive engineers, either by accident, sickness or sudden death, a correspondent suggests that all locomotives should be equipped with some form of automatic "safety throttle," similar in its action to the control levers on the motors of the New York and Boston subways, which automatically cut off the power the instant that the pressure of the driver's hand is removed.

Some years ago, the editor rode in the cab of one of the then newly-instituted 18-hour trains to Chicago, when he covered some 1,500 miles of the round trip in the locomotive cab. He noticed that generally, and particularly at night, the engineer would keep one hand upon the throttle, the other upon the air brake lever. An emergency stop was made by the instant operation of these two levers. It would, of course, be possible by means of some source of power, such as a pneumatically-controlled piston, to shut off the steam and apply the brakes at the instant that the engineer's hand dropped from the throttle, either through accident or death. The objection to such an arrangement would be that there are times when he must remove his hand from the throttle, as for instance when it is necessary to sand the rails or open the cylinder drain cocks. On the other hand, the safety stop might be so arranged that it could be temporarily locked in position at the will of the engineer. In these days of huge boilers and large fire boxes, it becomes increasingly difficult for the fireman to supplement the watchfulness of the engineer. Locomotive engineers as a body would welcome, we believe, any practicable safeguard of this character, and it would materially add to the safety of railroad travel.

A German Criticism of the Panama Canal

THERE recently appeared in *Prometheus* a review of conditions and prospects at the Isthmus of Panama, which may probably be taken as representing the average German view of our stupendous task of cutting a waterway from the Atlantic to the Pacific at that point.

It takes but a cursory reading of the article, which will be found in full in the current issue of the SUPPLEMENT, to convey the impression that the writer is strongly pessimistic, both as to the completion of the canal in 1915, and as to its commercial utility after it has been thrown open for traffic. American reports of rapid progress are considered to be "very optimistic"; "extraordinary obstacles have yet to be overcome"; and "the officials responsible for the canal are beset by worries and fears."

Of the five kinds of difficulties: sanitary, financial, technical, geological, and commercial, enumerated by *Prometheus*, it is admitted that the Americans, who have proved themselves masters of the art of sanitation, have surmounted the hygienic and climatic obstacles which all but prevented the construction of the Panama Railway half a century ago. Seeing that the United States regards it as a matter of national honor to carry the work through, the financial basis of the enterprise is considered to be secure.

It is easy for any one who is familiar with the canal problem to predict the line of criticism which will be followed by any one who approaches the unusual geological and technical difficulties which the construction of the canal has opened up. In the present case, the security of the Gatun Dam and the permanence of the slopes of the Culebra Cut are called in question; but in neither case is any new light shed upon the subject, nor are any possibilities of failure suggested which have not been made the subject of careful study and practical experiment by the engineers in charge of the work. An experimental dam has demonstrated that the materials used in the hydraulically built-up Gatun Dam will be proof against seepage; and there is no evidence that any continuous and out-cropping strata of pervious material is to be found in either of the two underlying geological gorges, which will form part of the foundation upon which the dam will rest. Compacted by the great weight of the overlying dam, 120 feet in height, the underlying material, as revealed by hundreds of borings, is such that there is every reason to believe that the sub-surface, thoroughly compacted by the enormous weight of the overlying dam, will prove to be as water-tight as the dam itself. It is true, as *Prometheus* states, that "this construction has been much discussed and severely criticised in America"; but it should be noted that this criticism was made before the extensive borings and the carefully carried out tests had demonstrated to the satisfaction of our engineers that the structure will be stable and secure against seepage.

Regarding the unquestionably serious slides in the Culebra Cut, to which much attention is given, it is sufficient to say that these slides were expected and provided for in the estimate of final cost. The unstable character of the Culebra Mountain had been suggested by the experience of the French when they commenced the cutting, and further established by the borings made by the American engineers. An estimate of six million dollars was made by Col. Goethals to cover the probable extra cost of removing the slides. The latest advices from the Isthmus are to the effect that on the more important of the slides, the movement appears to have ceased, and that present indications show that the appropriation will be sufficient to cover any further movements of this character. Certainly it is not true that the "heavy rains and floods sometimes make the most careful and elaborate calculations utterly useless." Careful records of climatic conditions for many years past have made it possible for the engineers, by basing their calculations upon the maximum rainfall and maximum flood discharge, to make ample provision for every possible contingency.

Finally and inevitably, the writer in *Prometheus* brings to the front the old bugaboo of damage by possible earthquakes, although it is distinctly to his credit that, unlike some American critics, he impartially points to the fact that the Panama region is comparatively free from such violent earthquakes as frequently occur in Central America. The last earthquake of a violent character took place in 1621, nearly three hundred years ago, and since then the Isthmus of Panama has experienced only very slight shocks, the most notable of which occurred in 1882. It is our own belief that slight disturbances of this character would have no material effect either upon the earthen dams or the concrete locks. Furthermore, we believe that because of their great mass, not merely the dams, but the locks themselves, would pass through an earthquake of some severity without either fracture or displacement.

We are free to admit, however, that, when our critic comes to the question of the commercial future of the canal, he is much more to the point. He considers it doubtful if the Panama Canal is destined to become the "important artery of commerce and the worthy rival of the Suez Canal that it is designed to be," believing that it makes its appearance too late to render to civilization the service that it might have rendered at an earlier date in the history of the commercial world. Had the canal always existed, the history of development might have been very different; the northeastern part of the Pacific Ocean would not have remained almost unknown until the middle of the nineteenth century, and the route of traffic between Europe and Australia and eastern Asia would have been via Panama, and would have become so established that it could scarcely have been diverted by the construction of the Suez Canal. But the development of the present trade routes has been based on the absence of a Panama Canal, and the great question is, how far can the opening of this waterway serve as a diversion?

The writer believes that the existence of the eleven trans-continental roads in Canada and the United States, and the recent opening of similar routes across South America, to say nothing of the excellent Tehuantepec Railway, have largely removed the trade necessities which, in former years, called so loudly for the construction of the Panama waterway. Very significant is his comparison of the values in millions of dollars of merchandise which was shipped from American ports to both American and foreign ports, via Panama and Tehuantepec, in successive years from 1907 to 1910. In 1906-7 the value for Panama was $9,600,000; in 1909-10 this had risen to $12,800,000. The value for the Tehuantepec Railway for five and one-third months in 1906-7 (the year of opening), was $11,450,000, and in 1909 to 1910 this had risen for the twelve months to the astonishing total of $69,600,000.

How far the forecast of this German review will prove to be correct, time alone can tell. It is our opinion that the advantages of shipment from port to port, without breaking bulk, will prove to be too great for successful competition either by our own trans-continental railroads, or those of Mexico and Central and South America. The appearance of this ably-written article, however, is another proof of the careful study which foreign nations are making of the commercial aspects of the canal. It is quite a question whether our own commercial bodies and the federal government are giving this subject the early attention which it requires. If the general commerce of the United States and the interests of its merchant marine are to reap the legitimate fruits of this great national undertaking, we should take early steps to safeguard our interests by suitable legislation. It would be perfectly proper to pass a law extending to all commerce between United States ports on the Atlantic and Pacific by way of the canal, those benefits which are secured by our present coast-wise traffic—in other words, Congress should recognize such traffic between American ports via the Canal as forming part of our coast-wise traffic by excluding all foreign ships from participation therein. The passage of a law to this effect would unquestionably prove to be a most effective means for promoting the upbuilding of the American merchant marine.

Henry Walter Nernst

A Great Physical Chemist

By Prof. William J. Humphreys, United States Weather Bureau

THE present director of the Physico-Chemical Institute of the University of Berlin, Prof. Henry Walter Nernst, was born at Briesen, West Prussia, June 25th, 1864. He is, therefore, a much younger man than the volume and importance of his work would lead one to suspect.

Intimate glimpses of a scientific man's daily life are often full of interest, especially when they reveal peculiarities or seeming eccentricities due to the nature and intensity of his work. In the present instance, however, these peculiarities will be left to the discussion of his intimate friends, whom, doubtless, they sometimes amuse but never offend. For the rest of us the name Nernst calls to mind chiefly a number of important contributions to the science of physical chemistry, and hence it is with these alone that the following is concerned.

In order to get a proper appreciation of Nernst's contributions to human knowledge, it is necessary briefly to review the cultivation of that fertile field of science that lies midway between the chemistry of Lavoisier and the physics of Newton.

As a matter of fact there is not now, and never has been, a sharp boundary between physics and chemistry. Hence a great mass of information that to-day would be grouped under the general heading, "Physical Chemistry," was accumulated long before any one ever thought of the above compromise title for it. Physical chemistry, then, in the sense of a knowledge of the physical properties of compounds, is not a new science. The melting and boiling points of many substances, their specific heats, atomic and molecular volumes, viscosities, spectra, powers to refract light, to rotate the plane of polarization, and the like, were long ago studied, as were also the changes in these properties owing to the addition or substitution of one or more elements.

The object of the earlier experimenters was exactly the same as that of the ablest of the later investigators. All sought, as every student of nature must, to co-ordinate apparently isolated facts through broad generalizations, or the assignment of them to a common cause. But while the experimental facts discovered by the earlier workers are of the greatest importance, only empirical and hence merely approximate relations were found.

The glory of the newer physical chemistry, that which justifies its claim to a position among the sciences, is the freedom of its laws from mere empiricism, and the exactness with which it enables one to calculate results by rigid mathematical processes. It is to this branch of chemistry, the branch that might even be termed mathematical chemistry, that Nernst has chiefly contributed. It must not be supposed, however, that he was the founder of this our newest science, for there are others, especially Ostwald, van't Hoff, and Arrhenius, with prior claims to that honor; but he has been and still is one of its chief builders.

One of Nernst's earliest contributions to physical chemistry was a rational explanation of the mutual effect of salts upon each other's solubility. It had long been known that in many cases two salts markedly interfere with each other's solubility in water, while others do not so interfere; but no satisfactory explanation had been offered for this phenomenon, nor was it possible, with a knowledge of the substances themselves, to predict what effect either would have upon the solution of the other. In this case, however, as often happens, the data necessary and sufficient to a complete solution of the problem were at hand, but it was Nernst who had the inspiration and the ability to use as premises the law of mass action, as developed by Guldberg and Waage, and Arrhenius's theory of electrolytic dissociation, and from them logically to deduce the exact cause and numerical extent of the effect of one salt on the solution of another.

Another of Nernst's many contributions to our knowledge is an explanation of why any dissolved substance, as cane sugar, for instance, gradually spreads or diffuses throughout the medium in which it is dissolved. Here use was made of the laws of osmotic pressure as formulated by van't Hoff—laws that in every particular are analogous to the laws of gas pressure.

Just as difference in gas density leads to gas diffusion, so does difference in concentration of a dissolved substance lead to its diffusion through the medium in which it is dissolved. Hence the distribution of osmotic pressure throughout a given solution determines both the direction and velocity of diffusion.

During recent years the investigation of chemical equalibra at high temperatures has occupied most of Nernst's attention. As every one knows, the properties of substances depend upon temperature. Up to a certain temperature iron, for instance, is easily magnetized, while at higher temperatures it is but slightly magnetic. At ordinary temperatures rubber is exceedingly flexible and elastic, but at the temperatures of liquid air it is as brittle as glass. And so it is with other substances, their properties are profoundly modified when the temperature is greatly changed, so that to know a substance thoroughly is to know its properties at all temperatures. Nor are the physical changes with temperature more pronounced than are the chemical. Substances that combine at one temperature decompose at another, and qualities that are in a state of chemical equilibrium at one temperature are thrown out of balance by heating or cooling. Hence change in temperature furnishes unlimited studies for the physical chemist—studies to which Nernst and his students have given the most attention, but with results which, while valuable, necessarily are still incomplete. The subject is so vast and so difficult that it will require years of work approximately to complete it.

Probably the general public, since it cares more for an art that serves its needs than it does for the science that rendered the art possible, knows of Nernst chiefly, if not solely, as the inventor of the electric glower that bears his name. This, however, like practically all other discoveries worth while, was the outcome, or, more exactly, a by-product of a purely scientific investigation, a careful study of the electrical conductivity of solid electrolytes. In the course of this work it was found that the oxides of certain rare elements possess properties that adapt them to economical use in electrical illumination. This was the always necessary discovery; the rest, in rendering the glower practicable, was but the ingenious combination of things already known.

To the scientific world, however, Nernst is best known as the man who first developed a satisfactory theory of the action of the primary electric cell; a theory that enables one to calculate beforehand just what electro-motive force will be generated by a given combination of elements and solutions.

The theory in question is based on three things, namely:

(a) van't Hoff's laws of osmotic pressure, or tendency of a dissolved substance to move from places of greater to places of less concentration.

(b) The electrolytic dissociation theory of Arrhenius, which accounts for certain properties of dissolved salts on the assumption that they are more or less broken down into their constituent parts and that these individual parts are electrified.

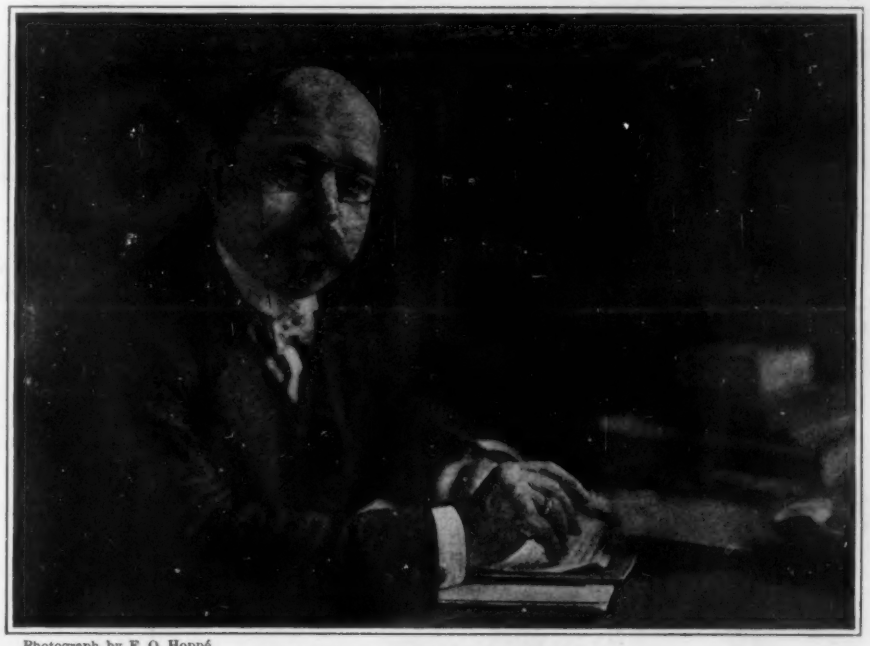
(c) Nernst's theory of solution tension, or the assumption that any metal, when placed in a liquid, even a solution of one of its own salts, dissolves to a certain extent, just as a liquid evaporates.

The theory of the action of primary cells not only accounted for the actions of all known cells of this nature, but even suggested previously untried combinations and foretold their action.

An exceedingly simple cell, but one that illustrates the theory, consists of two zinc rods dipping, the one into a concentrated, the other into a dilute water solution of zinc chloride. The tendency of the zinc to dissolve into the water—its solution tension—is the same in the two cases, but the osmotic pressure of the zinc ions furnished by the zinc chloride is greater in the concentrated than in the dilute solution. Hence, since the osmotic pressure and the solution tension are in opposite directions, a state of equilibrium requires a larger number of zinc particles to be dissolved from the zinc bar in the weak solution than from the one in the strong solution. But each zinc particle carries with it a definite charge of positive electricity, and consequently both zinc rods are left negatively charged, though the one in the dilute solution is more strongly charged than is the one in the concentrated solution. Therefore, when the two zinc rods are connected by means of an electrical conductor, and the circuit is otherwise properly completed, a current flows from the less negatively to the more negatively charged rod outside the solutions, and in the reverse direction within the solutions. This, of course, destroys the balance, in both solutions, between the solution tension and osmotic pressure. In the diluted solution the advantage, after the balance is destroyed, is on the side of the solution tension, while in the more concentrated solution it is with the osmotic pressure. Hence, zinc is dissolved and added to the dilute solution from the rod that is in it, and at the same time an equal amount removed from the other solution and deposited on the rod it contains, till, in the end, the two solutions are of equal strength.

At all times, and in all similar cells, the electromotive force is directly proportional to the logarithm of the difference between the two osmotic pressures, and is numerically calculable.

Such, then, are some of Nernst's important contributions to science, and there is every reason, judging from his industry, ability and position, to expect still others of great value.



Photograph by E. O. Hoppé

PROF. HENRY WALTER NERNST

New Life Preserver

RECENT consular reports describe a new form of life preserver, which it is proposed to introduce into the German Navy. It consists of two swimming cushions bound together by straps and arranged to lie upon the breast and back. The novel feature of the apparatus is an electric lamp, which is worn on the forehead. The lamp burns 3 or 4 hours, and is provided with a reflector, which throws its light for a distance of several hundred yards at night. The life preserver can be buckled on in 5 seconds.

Artificial Life

II. Making the Non-Living Do the Work of the Living

By Benjamin C. Gruenberg

WE have seen that the body of scientific research which has to do with what is popularly termed "artificial life" takes on two distinct phases.* The first has to do with the creation of an artificial system or "machine" which behaves more or less like a living body, or like the living substance called "protoplasm." The second has to do with causing eggs to develop without being fertilized—"artificial parthenogenesis."

Before the discovery of the sperm in the seventeenth century, the nature of fertilization was absolutely unknown. It was in 1677 that the Dutch scientist Lieuwenhoek first saw the sperms of certain animals, but these swimming cells were at first regarded as parasites. The assumption among men of science was that the essential thing in fertilization was the fluid in which the sperms float. But the Italian monk Spallanzani, who was in some ways ahead of his time in his methods, filtered some spermatic fluid and showed that the sperms were the essential factors. This was more than a hundred years after the little "animalcules" had been discovered, and still nothing could be known of the nature of fertilization, because nothing was known of the nature of the egg. After the establishment of the "cell theory" of the structure of living things in 1838-39, it was possible to get the notion that the egg is a *cell;* and a few years later (1845) the actual union of sperm and egg cells was directly observed, although the sperm was not yet recognized as being also a cell until twenty years later. During all these years, however, there was an abundance of speculation. This concerned itself with two major problems, which overlap in parts. The first is, how does a hen's egg, for example, become metamorphosed into a chick? The second is, what is the share of each parent in the developing egg?

The first of these questions *could* not be answered in the latter part of the eighteenth century, when speculation probably reached the high-water mark. There were two leading theories, with endless argument and debate. According to one theory the egg contained within itself a minute duplicate of the parent, and that this simply grew and developed. The extreme exponent of this "preformation theory" was the French naturalist, Charles Bonnet, at whose hands it developed into the absurdity that the parent bore these eggs with their preformed minute embryos while she was still herself in the egg, and so on indefinitely to the beginning of life. This doctrine was later abandoned by Bonnet, and had very few adherents. But, as we shall see, there was more in it than its strongest advocates ever suspected. The alternative view was that the egg started as a body without any definite structure, and developed the complex structure gradually. This idea of "epigenesis" was forwarded by Caspar Friedrich Wolff, who had the sense to abandon speculation and resorted to observing what could actually be seen in the developing hen's egg. But this doctrine did not carry satisfactory conviction.

The second question above referred to, that of the share of each parent in the developing egg, was also chiefly the subject for speculation and dispute. According to one school, the essential thing is the egg; the sperm serves merely as a stimulus for development. According to the other, the sperm is the essential thing; the egg merely supplies the nutriment for its development. Since 1875, however, we know that both elements enter into the make-up of the developing cells. In this year Oscar Hertwig and other biologists were able to observe directly the union of elements from the egg nucleus with elements from the sperm nucleus (Fig. 2).

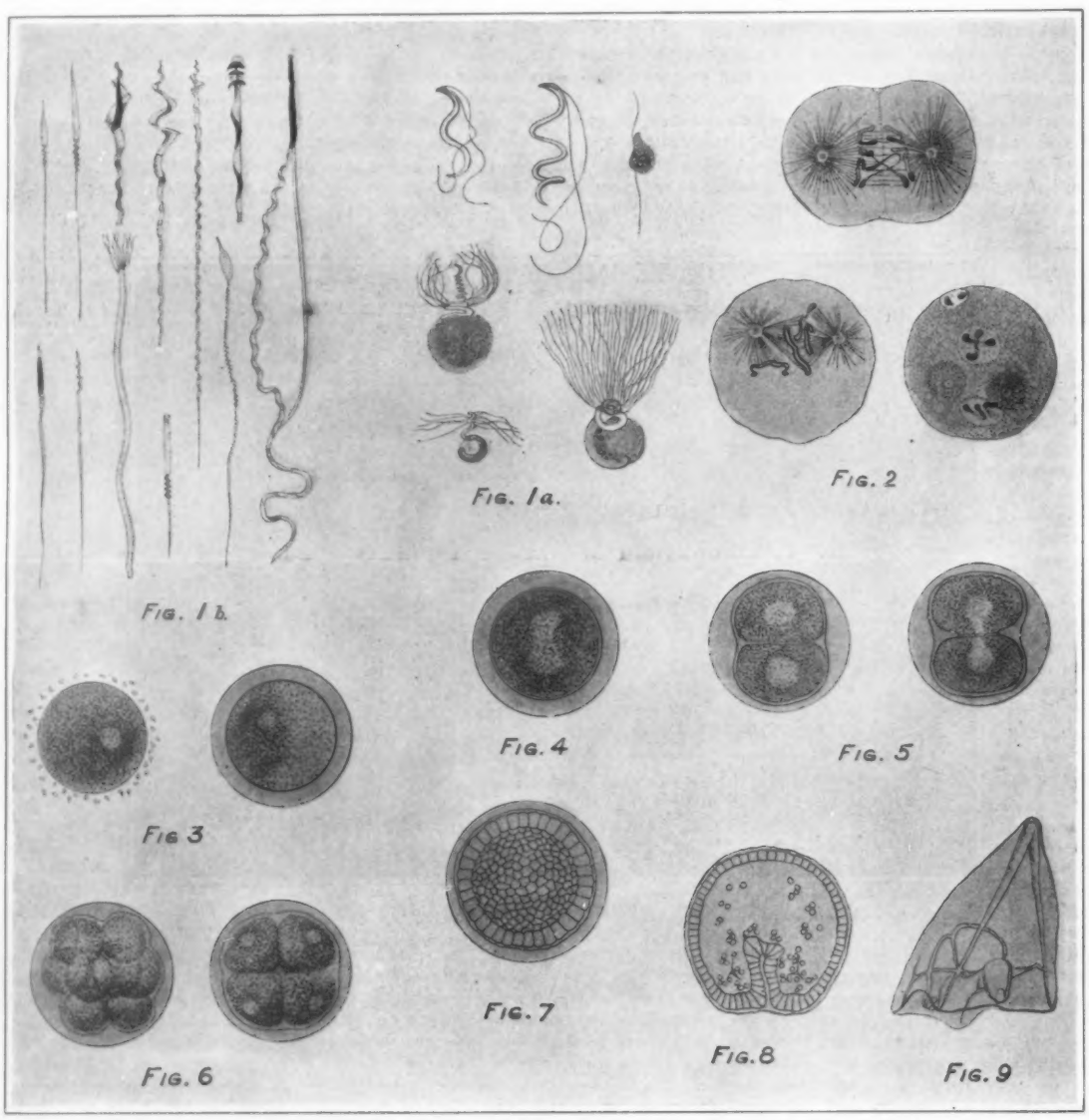
The debate between preformation and epigenesis has now no real meaning. Epigenesis is true in the sense that the fertilized egg from which the organism develops does not contain any preformed structure corresponding to the anatomy of the plant or animal into which it is to develop. On the other hand, the preformation theory was true in this sense: the fertilized egg cell contains elements that were present in the parents, which in turn derived them from their parents and so on indefinitely. In other words, the question that these speculations attempted to answer is in reality two questions: one has to do with the mechanics of development, the other has to do with heredity. The fact of fertilization has also this double aspect: it introduces into the egg the elements that make up the heredity from the male parent; and it starts the activity of the egg that leads to development.

These two aspects of fertilization have been experimentally demonstrated in a number of ways. The relation to heredity is shown by the fact of hybridization; indeed, it is through the study of hybrids that we have in recent years gathered the bulk of what we know about heredity. That the elements which "bear the heredity," or determine in some way the character of the organism, are carried by the nucleus was shown in an experiment by Boveri.

He cut the eggs (unfertilized) of sea-urchins, so that some pieces were without nuclear matter. These pieces he placed in sea water containing the sperms of another species of sea-urchin; the sperms fused with pieces of egg protoplasm. The egg began to develop, and when it got far enough along to be identified, it turned out to have the characters of only its male parent. As the nucleus cannot be removed from a sperm-cell without killing it (since the sperm is practically all nucleus) the reciprocal experiment cannot be performed. But the same results are obtained if an egg is made to develop without fertilization.

There are many animals and plants whose eggs normally develop without fertilization—either regularly, or under special conditions. For example, plant lice produce during the warm weather large numbers of eggs which develop into organisms like the mother without being fertilized, although another series of eggs, produced in the fall, cannot develop without fertilization. The same is true of certain species of "water fleas." The queen bee sometimes lays eggs that develop without being fertilized; these always develop into drones, and occasionally a worker-bee lays eggs which also develop without fertilization. This phenomenon is called *parthenogenesis*, and attempts to produce parthenogenetic development artificially have been made for a long time as it was expected that by this means we could get a clue to the physico-chemical-

(Continued on page 285.)



1a, Sperms of various plants. 1b, Sperms and eggs of various animals. 2, Fusion of nuclear elements from sperm and egg in fertilization. 3a, Unfertilized sea-urchin egg surrounded by sperms. 3b, The same after the entrance of a sperm and the formation of a "fertilization membrane."—After Loeb. 4, Beginning of the first nuclear division in fertilized egg.—After Loeb. 5, Completion of the first cell division in the segmentation of the fertilized egg.—After Loeb. 6, Four-cell and eight-cell stages in segmentation of the egg.—After Loeb. 7, Hollow ball of cells; the "blastula" stage in the development of the sea-urchin and other animals.—After Loeb. 8, Two-layered cup of cells; the "gastrula" stage in the development of the sea-urchin and of other animals.—After Loeb. 9, The "pluteus" stage in the development of the sea-urchin larva.—After Loeb.

EGGS AND THEIR DEVELOPMENT

*See *Scientific American*, September 9th, 1911.

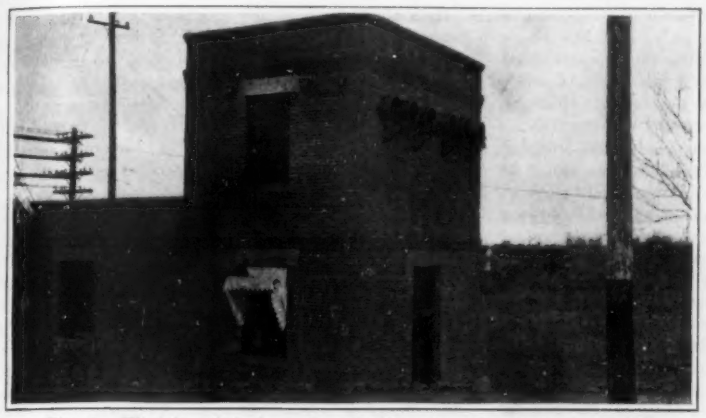


Fig. 1.—Electric substation where 44,000 volts transmission potential is reduced to 13,200 or 6,600 volts and supplied to farmers on lateral branch circuits.

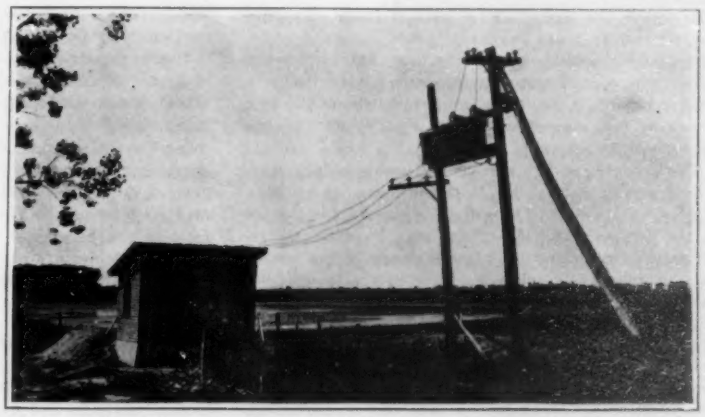


Fig. 2.—Alternating current motor driving irrigation pump fed by 2,200 volt farmer service through transformers which reduce the potential to 200 volts at the motor terminals.

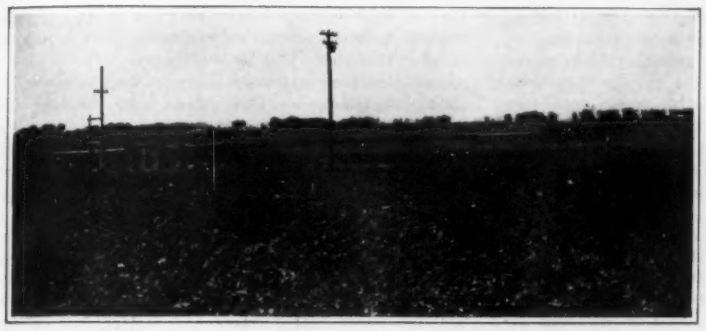


Fig. 3.—Thrifty crops on irrigated lands. Electric pump equipment lifts the water from the water service trench nearby and from the low meadow adjoining.

Fig. 4.—An excellent hay crop on a low meadow land drained by the electric pump equipment shown in Fig. 3.

Central Station Current for Farms

Advantages of Introducing Electricity into Rural Districts

By T. Commerford Martin and Putnam A Bates

UP to the present time, with 6,000 central station companies in the United States, there has never been a company or plant established to supply electricity to a farming region. Perhaps there never will be. Conditions in the central station industry have changed so rapidly in thirty years that electrical supply, once the peculiar enjoyment of residents in a limited city area is now available, from the one source, over hundreds of square miles. The Boston Edison company, which began twenty-five years ago with a little area of perhaps half a mile around Faneuil Hall, now covers a large part of Massachusetts with its circuits, and has many farm supply problems on its hands. Around Chicago, the North Shore Electric Company furnishes 24-hour current to a population of 250,000, in an area of 1,200 square miles, reaching 71 cities and towns, and some hamlets with barely 100 people. It has already many farmers on its books, and will soon have many more on its lines. The Public Service Company of New Jersey covers with its circuits the whole of the northern part of the State. Out in California, from the Sierras, electrical energy is fed to San Francisco over 200 miles away, and the circuits of the one system embracing more than half the counties in the State, are availed of already by many a farmer who never expects to have a railway track laid in front of his barn yard. It has been proposed to throw into 25 or 30 plants, the generating capacity of all the 400 existing central stations of New York State, because it is so easy now to distribute electricity that is made economically in great quantity. In England, the idea has boldly been put forward by Ferranti of using in about 100 central stations 60 million tons of coal, to supply the whole country, farmers included, with electricity at as low a price as ¼ cent per kilowatt hour—1 1/3 horsepower for an hour for half a farthing. Here in varying instances we have reality and dream, but all emphasizing the immense fact that electricity has ceased to be the servant merely of the city population, and now regards as within its reach any populated district where poles can be set and wires strung.

It is needless to go into the technical details of the process of engineering and invention to which this expansion must be attributed. Three main factors are involved, namely, the adoption of the alternating current, the utilization of water powers, and the resort to higher pressures of current. Of all these changes the farmer is especially the beneficiary at present, and destined to be even more so in the near future. The methods of supply have been tried out and firmly established. The questions now confronting the central station manager, and already being dealt with by him in a great many instances are those of specific local distribution and service. Sometimes the farmer has still to consider the problem merely for himself. The farmer may install his own private electric generating plant, or several neighbors might band together and construct a power station of their own, each being served on the co-operative plan. The most extensive use of electricity, however, in the rural or farming districts will, unquestionably, come as a development of present central station systems or the organization of companies having as their prime object, the serving of farmers' needs, through well planned electric plants located in the heart of the agricultural sections.

During 1910-11 a canvass was made by a committee, specially appointed by the National Electric Light Association, to investigate the work of the various central stations in its membership in developing and caring for the electric power and lighting service to farms and in rural districts. The result of this canvass was embodied in a report prepared by this rural electric service committee, of which Mr. J. G. Learned was chairman, and presented before the National Electric Light Association's annual convention, May 29th, 1911. The evidence brought out in the report is most interesting and encouraging.

Interesting data and valuable suggestions are, therefore, now before us on this new problem of extending central station electric service to the farmer. In mapping out territory, the central station can no longer regard the outlying sections as of no immediate concern. They are to be reckoned with, and preparations should be under way to develop this business along lines that would insure handling it on such a basis as will give satisfaction to the farmer, and be profitable to the service company.

It is clear, from the reports of several electric plants, where the rural business has been developed along good engineering lines and the farmer assisted in the solution of his somewhat complex mechanical farm problems, that this service is profitable. Other central station companies are now making elaborate plans for carrying out methods of farm supply.

The uses to which electricity can be advantageously applied in rural districts are many, and far more in fact than one would at first suppose. For reasons of safety and labor saving, the need for electricity is really greater in farming districts than in the more densely populated sections, owing to the comparative isolation and consequent difficulty in obtaining labor. In the agricultural sections where stock farming is carried on, or where there is considerable water to be pumped for irrigation purposes, the use of electric power is well recognized as a decided betterment and it is in such districts, largely, that one will find the greatest opportunity for immediate progress.

Broadly stated, the stock breeding and stock feeding districts require more power than truck gardening districts. A stock farm requires to have conveniently within its reach at least 25 horse-power for feed grinding, ensilage cutting, threshing, pumping and a variety of similar uses. The operation of dairies and creameries also requires considerable power and is an inviting field for the use of electricity.

Naturally, the farmer is not compelled to use electricity, for there are several types of agricultural power apparatus utilizing steam, oil, heated air or other source of energy, which may usually be employed at a somewhat less first cost, but the convenience, absence of risk and cleanliness of electric service are features which he values. It is not necessary, therefore, to exert much effort in explaining the advantage of electricity, but the question is on what basis shall the service be supplied?

The conditions incident to the supply of electricity in the rural or farming districts differ so materially from those in the towns and cities that when the "farm" is considered, one is in the habit of regarding the proposition as undesirable, because one does not clearly see the manner in which such service may be economically rendered nor the extensive uses to which electricity may be applied in agriculture. This ignorance is not a universal condition by any means, but it is illustrative of the atmosphere surrounding many central stations, located adjacent to good farming sections.

In northern Colorado, we find a progressive company that apparently has attacked the problem in the right manner, and some of the characteristic features of the service supplied are illustrated in the accompanying photographs. In the center of the more thickly settled sections, sub or distributing stations of the type shown in Fig. 1 are erected, the object being to locate points to which to build heavy distribution feeder lines and from these substations as centers to feed out lateral branches.

This system embodies good engineering methods

and makes the current transmission costs such that for farmer business the same rates are charged as those asked within the towns, the only difference being that a minimum charge is made to insure a reasonable return for the extra investment in the pole lines, the first cost of which this central station company finds it agreeable to bear.

The planning of this system has been carefully done and the company's policy is to encourage the utilization of its current. The soliciting agents are trained in the uses to which electricity may be efficiently applied in farming and their success in securing results and business rests solely on their power to convince the farmers of the merit of each idea suggested.

It is quite natural that the rural consumers will require more individual attention from electrical solicitors, owing to the entire reliance of the farmer on this source for information. This makes farmers somewhat more expensive to care for as customers, but in the period of development it is money well spent, as friendship is created or cemented and new uses are found for current.

An especially desirable feature of the farmers' service is the fact that the power or principal portion of their current requirement is entirely during the daytime, which makes a tendency to balance up the load on the power station without adding to the "peak" load conditions. It is, therefore, obvious that many plants in smaller cities can supply farms during the day and their urban customers at night, from the same generators.

Figs. 2, 3, and 4 illustrate water electrically pumped, for irrigation purposes, which is an important field for the use of power in any agricultural section.

Fig. 2 shows a small inexpensive housing for the electric pumping plant, which elevates the water from a reservoir, a corner of which is shown in the background. The water is delivered from the pump through a system of trenches upon an acreage of sugar beets. In nearly all western States it is impossible to raise fruit, grain or garden crops without the aid of irrigation. Everywhere crops would gain if irrigation were more general.

Gravity irrigation is not always possible, due to the level of the land, with respect to the water source. To irrigate these high lands, which are often more valuable than the lower lands, it is necessary to raise the water by pumping.

A general view of one of these electric pumping equipments is illustrated in Fig. 3, while Fig. 4 shows quite another condition, in that the land of this particular field is so low that water would naturally collect in places, forming marshes. The pumping equipment seen in Fig. 3 is utilized to keep this field drained during the season of irrigation; and the large field of potatoes—the foreground of the illustration—receives the benefit of this water.

The central station system above referred to, and of which these illustrations are photographs, would be entirely appropriate as a means for mastering the farmers' electric service problem in any locality, and while the uses to which electricity may be applied differ in the various localities, these illustrations are especially significant. The more extensive use of irrigating methods and power applications for general purposes must be adopted in successful farming systems of the future. This fact at once suggests a new field for the central station service that will no longer be neglected.

It was the introduction of electric motors that enabled manufacturers of all classes to determine definitely their power costs. The results thus obtained, through the elimination of belting and shafting losses and by measuring directly effective power used, were surprising.

On the farm, the advantages of such a change lie in another direction. The saving in power is not so important, for the amount of energy needed for this purpose is never so great as in the manufacturing establishment. The "ever ready" feature of the electric motor is here its chief advantage. Moreover oils and other combustible fuels, useful as they are, always introduce a decided additional fire risk wherever used, and of necessity farms are isolated in outlying districts away from organized fire protection. Small power engines, using gas or oil fuel, may be placed at a distance from buildings when in operation, which of course is safer, but not so convenient. The danger, however, cannot be so readily lessened in the use of oil lamps, matches and lanterns, nor is it very convenient to have to go outside to a point distant from the central buildings whenever power work is done.

It is the inconvenience of things that often spells failure for farmers. With a minimum of labor at command and a maximum of work to do throughout most seasons of the year, a direct saving in time of getting ready on each operation is all important.

From this point of view, therefore, the utilization of central station electricity for farming sections within striking distance of established power houses is ideal.

The central station manager and the farmer have different "angles of attack," but in reality their interests are the same. It takes time, however, to size up correctly a new situation of this kind, and this fact accounts for the tardy development of electrical matters in rural districts.

The successful farmer of to-day is vastly different from the farmer of a generation ago. He operates, maintains and develops his farm with the care and shrewdness of a business man. He analyzes his soil with the sole purpose of determining or of adapting to it the kind of crops best adapted to its characteristics and conditions.

He realizes that his stock must no longer trample tons of fodder under foot during the feeding season. Instead, he must cut the roughage and feed it in such manner that there will be little waste. The result of adopting such an obviously better method is success.

All this, however, takes power, and the old time tread mill is too awkward to harmonize with the situation under the improved conditions. Power machinery, therefore, becomes a necessity, and the electric motor is ever the dream of the man who wishes to be abreast of the times.

The matter of finance has yet to be mastered by most farmers, and central station men must remember this when arranging for the farmer's initial investment. It will be policy to find a way to provide the line wires, transformers and meters, but cutting and hauling poles is a farmer's work and one can well leave this to him. He is often a skillful mechanician, familiar with the technique of a trade, and he or his sons take just as kindly to the handling of a dynamo or motor as they do to the operation of an automobile. The main thing to do in introducing electrical applications on the farm is to utilize—not in the city but on the spot—all these latent possibilities.

A New System of Bunkering Steamships

The "Herald" and Her Performances

By F. C. Coleman

ONE of the latest developments in the bunkering of steamers is represented in the "Herald," a twin-screw coaling vessel shown in the photographs. The "Herald" is fitted on the Holland-Johnston system with two elevators, and has a speed through the water of 6 knots. The capacity of the vessel is 400 tons of coal, and the output 100 tons per hour per elevator, i. e., 200 tons per hour for the vessel. Our frontispiece shows the "Herald" bunkering the London & North-Western Railway Company's mail steamer "Anglia," and gives a clear idea of the construction of the vessel. The coal is carried in pockets or compartments on each side of the vessel. Between the compartments and extending nearly from one end of the coaler to the other, is a longitudinal passage up and down which the movable elevators are free to travel. The system is novel and differs from other coaling methods, inasmuch as though the "Herald" has only two elevators, larger vessels fitted in the same way might have three, four or five elevators; and with each of these elevators, having an output of 100 tons per hour, it would be possible for a vessel so fitted to discharge herself at the rate of 500 tons per hour. Large ocean liners served by large vessels of the "Herald" type, one on either side of the liner, such as the "Mauretania" or "Lusitania" and the big vessels of the White Star Line, could thus be coaled at the rate of 1,000 tons per hour.

A thousand tons per hour may appear a very large quantity of coal to transfer from barge to steamer, and it can only be done by a system such as that on which the "Herald" is constructed, because to attempt to pass that quantity of coal down one shoot, or even two shoots, would mean that the discharge would have to be so rapid that the delivery of it could not properly be taken. In the "Herald" system, however, different shoots are put through the side bunker doors in different parts of the vessel and coaling is thus going on simultaneously in practically all parts of the vessel's bunkers, consequently, the only delay with this method will be at the final trimming in the top of the bunkers, which must always be a slow operation.

The elevators may be moved from any one point in the trunk to another, being carried by the trucks on rails, which are shown in the photographs. In addition to this flexibility of the positions of the elevators, the barge itself can, of course, be moved, consequently there is no doubt that any vessel with side bunker doors may be coaled by this design of plant.

When supplying coal to vessels provided with center bunker hatches instead of shoots, conveyors are put into operation for the purpose. With other systems of coaling a great drawback is experienced with the fine coal dust or dirt which gets blown about by the wind and covers the vessel being coaled from end to end with dirt. Compare these systems with the method of loading the London & North-Western Railway Company's mail steamer "Anglia," by the "Herald," and it will be seen that the complete absence of dust in the case is remarkable. Coaling by means of the "Herald" is a very clean operation. No dust whatever gets on board the vessel being coaled.

The elevators are driven by a very ingenious multiple gear in the top pentagon drum; the small engine necessary for the purpose being contained at the head of the elevator between the top and the bottom trunks. The exhaust steam from this engine is admitted into the head of the elevator in a suitable position, and is directed along the shoots into the vessel's bunker doors. The illustration shows the steam. It was found by experience that coal dust is carried straight into the vessel's bunkers with the steam, thus insuring an extremely clean method of coaling steamers. It is stated that the steam does not in any way wet the coal.

With two elevators, the crew of the "Herald" consists of the master, the engineer, the assistant engineer, a fireman and three deck hands. This crew is sufficient to navigate her and do all that is necessary in connection with the bunkering of steamers. The salient features claimed for this bunkering system are: Flexibilty as regards the shoots, cleanliness, rapidity and economy.

The Brooks Comet

By Prof. W. R. Brooks

THE new comet discovered in July by Dr. William R. Brooks, director of the Smith Observatory, Geneva, N. Y., is now visible to the naked eye, and in a very favorable position for observation on the western side of Pegasus. The comet has moved up through the northern part of Cygnus, and on September 10th was about 20 degrees northwest of Vega, the brilliant star in the constellation Lyra, and now overhead in the early evening. This was its greatest north declination, about 57 degrees. From this place the comet is moving first westerly, then southwesterly as it speeds toward the sun.

The following ephemeris will show the comet's track through the northwestern heavens. Those not having telescopes with graduated circles, can plot these positions upon a good star atlas, and thus get the comet's relative place to the well marked stars in its course:

September.	R. A.	N. Declination.
13	17 hrs. 10 min.	+57 deg. 9 min.
17	16 " 18 "	55 " 42 "
21	15 " 31 "	53 " 00 "
25	14 " 51 "	49 " 21 "
29	14 " 17 "	44 " 58 "
October.		
3	13 " 49 "	40 " 6 "
7	13 " 26 "	34 " 51 "

The comet was nearest the earth on September 17th, when its distance was 45,000,000 miles. While the comet is visible to the naked eye, an opera or field glass will add to the pleasure of the observation.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Octave Chanute and H. T. Ricketts—A Sidelight

To the Editor of the SCIENTIFIC AMERICAN:

The very appreciative article on Octave Chanute by Prof. Zahm, in your issue of May 13th, recalls an interesting coincidence occurring not far from the commencement of certain close relations between the writer and Mr. Chanute during the last eighteen years of his life.

One morning in the early summer of 1896 Mr. Chanute inquired, somewhat quizzically, but in his usual serious and methodical manner, as to a young doctor who might not be too busy or too dignified to accompany him—for a consideration—on an expedition where he, the doctor, would be expected to do cooking during the few spare moments when he was not engaged in the professional duty of setting broken limbs.

This inquiry was typical of Mr. Chanute's customary way of launching an enterprise—foresightedness, economy of service, shrewd calculation of adequate margins of safety, were but outcomes of his instinct and distinguished training as a bridge engineer. Having tried out his air planes and kites among the tin cans and sand lots at the foot of Huron Street, he was preparing for his gliding experiments at Dune Park, Ind. With the fate of Otto Lilienthal fresh in his mind, he did not propose to let the members of his little company smash their bones without having some representative of the coroner available. It was a part of his spirit of cautious frugality that had he been spiritually minded he would have proceeded just as methodically to secure the services of a chaplain willing to take on a side line of washing while waiting for emergencies.

I knew Mr. Chanute too well not to receive his request in the same spirit of courtly gravity in which it was made. And here is where the coincidence came in—I sent with him a solemn-faced conscientious student of medicine then helping me in my office, who was as single-minded a crusader in his own sphere of science as was Octave Chanute in his. What Howard Ricketts did not know about cooking, his temporary employer—a Frenchman and an epicure—informed me, would have filled a large Creole cook book, and as a surgeon he never had a tryout on Herring's or Avery's legs. But locked up even then in my young friend's breast was the purest, most deeply religious and unselfish love of science with which I have ever been privileged to come into intimate contact. Ricketts had no money; he cared nothing for it except as a means toward achieving his ambition to become an independent thinker in the sphere of pathological biology. He sat up nights with his ideas until his health was ruined, and his friends began to think him obsessed; perhaps he was a little so on commonplace subjects, but it was the obsession of preoccupation with connected thought, a form of mental peculiarity uncommon enough to seem queer to most of us, who are willing—*post hoc*—to admit that genius is usually a form of successful queerness.

Curious, was it not, that the lives of these two great serious and clean-minded scientists should have touched thus semi-comically and casually, only to drift presently apart again without influence upon or understanding of each other. Ricketts always thought "flying" was the one really jocular event of his life, and expected to eventually hear of his patron's incarceration for too lavish expenditure of money on box kites. Mr. Chanute associated Ricketts with nothing but spoiled meals, and pursued the disagreeable subject no farther—of what use was biology to the mathematician? And so each of these productive nineteenth century materialists thought the other a hopeless, useless visionary!

Yet Ricketts, like Chanute, "dreamed true," and his brief life with its tragic end—a last willing offering to his great goddess—was crowded full of those undramatizable epics of the modern laboratory that recall to us, if we have but the logical imagination to see them in their true stature, the heroic lives of early explorers, patriots, or religious enthusiasts. Pasteur and Metschnikoff gave him of their inspiration and technique. Animated by their methods, he struck out into new-world fields and returned with or finally sent back fresh contributions to science, destined also to prove of inestimable practical value to humanity. His original studies in pathological biology have never been equaled on this continent. His discoveries in blastomycosis gave him early recognition, and won for him an appointment at the University of Chicago. He spent three years studying the hitherto mysterious "tick fever" of the Rocky Mountains, and placed its etiology and pathology on a firm foundation. His experimental work in the immunity of organs received world-wide recognition and won for him in 1910, when barely thirty-eight years of age, the appointment to the chair of pathology at the University of Pennsylvania. As an especial mark of honor, the appointment carried with it a year's preliminary freedom for research work at a full salary, before entering upon active teaching service. As his final tribute to science he gave his life at its meridian in exchange for a knowledge of the secret sources of Mexican typhus. But not before that knowledge had matured from theory into fact, and the life history of the micro-organism of the disease lay unfolded before him under the microscope and in the culture medium. The Mexican government co-operated liberally with him during his work, and since his death in 1910 has given him unstinted recognition in an appreciative state paper transmitting his records to this country. We have now for the first time a complete biological and morphological history of the bacillus of typhus fever—a filth disease transmitted from human to human through the intervention of the body louse as an intermediate host. These records, with others of importance made by the same hand, have just been edited and published for the University of Chicago* and the Chicago Pathological Society.

It is not difficult for one who knew both of these natures well to see why they repelled and misunderstood each other. Their method in dealing with, and their mental attitude toward, facts were from opposite poles. Ricketts's method was intuitive and highly imaginative—an old-fashioned dreamer working backward from theories and ideals to facts. He saw the truth correctly but intuitively, the facts came inevitably but later. Chanute collected facts during a lifetime of mature and precise mathematical thinking, and by methods of pure induction arrived step by step at correctly demonstrated conclusions, eventually beyond even the insane dreams of Daris Green. And yet he also was an unselfish idealist, as is abundantly evidenced by his refusal to accept the commercial advantages which his basic patent on the biplane undoubtedly gave him. The several hundreds of unpublished letters, full of technical details and mathematical calculations, which passed between him and the Wright brothers, and which are now in the possession of the Chanute estate, would indicate that his interest and his equity in the machine-driven biplane, while not at all tainted with commercialism, were vastly more than passing and casual. The reported saying that he "turned up" or "happened to drop in" at Dayton or Kittyhawk in 1901 cut him deeply and was scant recognition when viewed in the light of this unique and instructive correspondence between two great scientific men. The secret of this interest is an open one to those who know the mainsprings of his life and character. That secret, after his modest fortune was acquired, was an abstract and impersonal devotion—incapable of jealousy—to the pursuits and achievements of pure science as apart from material gain and advancement. A motive power common enough in the old world, and still more so under the *ancien régime*—the day of Newton and Franklin, of Laplace and Priestly, of Humboldt and Goethe, but not commonly to be reckoned with amid the commercialism of present-day American life.

In the midst of and a recognized factor in contemporary supply and demand of modern railroad necessities, he still preserved unchanged the manner and family life of the French gentleman of the eighteenth century. Refinement, honesty, idealism, gentleness, all were his; yet he was full of fire in manner, spirit and inspiration. He was modest, yet he knew and gave himself his full value and dignity, as many of his letters abundantly show. In his seventy-ninth year his keen eyes sparkled like a boy's, and his wit was still as caustic as Montaigne's. On his death bed he corrected letters and telegrams with an enjoyment in the ultimate refinement of words that was altogether French. A many-sided nature in which were joined the pure philosophic altruism of the eighteenth century with the keen love for productive mathematics of the most modern American.

An early competence was won by strict business methods; then followed "retired leisure that in trim gardens takes its pleasure," only the gardens were the Illinois and Indiana sand dunes, and the leisure was an industrious but impersonal life in the fourth floor of a city house, surrounded by models and stuffed winged creatures and an abundant library of mathematical and engineering literature. The product of these voluntary labors, which he gave unselfishly to the world, showed as a net resultant all that was correct winnowed by patient experiment from a thousand ventures incorrect in their entirety. The Chanute biplane model, in its simplicity of line and principle, is a type of all those products of matured "genius" which are really the resultants of skillful elimination of the unnecessary and illusory. The accident of bodily age prevented personal flight. The accident of five years' delay in the development of the gasoline motor alone prevented the complete equipment of an otherwise perfect model.

It has been among the great privileges of my professional life to have had intimate contact with and to have formed an early appreciation of the value of these two great lives—lives so unlike in the details of their working out and surroundings, and yet so fundamentally similar in devotion to abstract science and in the altruistic determination to give largely and unselfishly that humanity might be the gainer.

Chicago, Ill. W. H. ALLPORT, M. D.

* Contributions to *Medical Science* by H. T. Ricketts, Univ. of Chicago Press, 1911.

Why Left-hand Mold-board Plows are Used

To the Editor of the SCIENTIFIC AMERICAN:

The following might be of interest to you in regard to the short article about mold-boards for plows in the SCIENTIFIC AMERICAN of June 17th, page 603.

As far as the work done by the plow is concerned, there is, of course, no difference between a left-hand and a right-hand mold-board plow. The choice between the two depends, however, on the manner in which the team (two horses or mules) is driven or guided. If a *single* line is used, it is customary to connect it to the left (lead) horse, in which case the team is entirely led by this horse and by one line (*single* connection between the left horse and driver).

After the first furrow has been made, it in itself is the best guide for the team, and since the second horse (right-hand horse as seen from the plow) is entirely guided by the "lead" horse, the latter should walk in the furrow. This arrangement, however, is possible only with a *left-hand* mold-board plow.

With one-horse plows, or when the team is driven by a double line, it makes theoretically no difference whatever whether the plow has a left-hand mold-board or a right-hand mold-board.

Washington, D. C. F. A. WEIHE.

Who Saw This Meteor Train?

To the Editor of the SCIENTIFIC AMERICAN:

On the night of September 4th, I noticed extending across the heavens at New City, N. Y., what I think must have been a "persistent meteor train" as recently described in the SCIENTIFIC AMERICAN. It first attracted my attention at about ten minutes past eight and was then in the northern sky in the form of a large circular arc not unlike a rainbow, but of much greater radius of curvature and extending almost completely across the sky from west to east.

The train drifted rather rapidly in a southerly direction and apparently straightened out as it reached the zenith, remaining perfectly straight until it was lost to view at a few minutes after nine.

The atmosphere was perfectly clear, the sky absolutely cloudless and the moon, nearly full, shone brightly in the southern sky. At first I thought it was a peculiar cloud formation, but it apparently had a luminosity of its own and someone remarked to me that, "It looks like the stuff of which the aurora borealis is made." Stars were plainly visible through the luminous mist and as it crossed the Square of Pegasus I noticed that it was almost as wide as the square, its length I estimated was 135 degrees or over.

As the streak crossed the moon's disk the section in front of the moon was made invisible by the bright light, but on each side the segments were still plainly visible although considerably narrower than when at first observed and still in a straight line.

I would be very much interested to know whether this peculiar luminous streak was seen by other persons and whether it has been reported by anyone who knows what it was. EDGAR PFARRE.

New York.

The National Tree of China

THE tung, or wood-oil, tree is worthily named the national tree of China. It is stately in appearance, with smooth green bark and wide-spreading branches, affording a fine shade. It bears a fruit resembling a shell bark hickory nut, but as large as a small orange. Each nut contains three triangular seeds similar to small Brazil nuts. The oil is pressed from these seeds, and the refuse is used as a fertilizer. The oil is used principally for polishing wood-work and dressing leather. Considerable quantities are exported.

The wood of the tung tree is used for making musical instruments, fine boxes and the framework of small houses. It is believed that this tree might flourish in warmer parts of the United States.

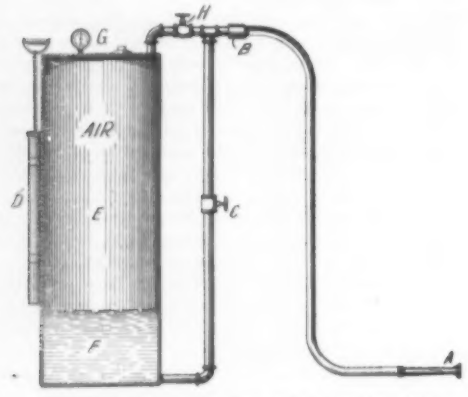
Suggestions for the Workshop

Ingenious Expedients of Resourceful Mechanics

Gasoline and Compressed Air for Cleaning

By J. E. N.

IT is a common practice in automobile shops to use gasoline and compressed air to clean the dirt from otherwise inaccessible parts of an automobile, the apparatus employed requires a specially made nozzle connected with a double line of hose. The apparatus illustrated in the accompanying engraving, which was made by a friend of the writer, accomplishes practically the same result in a simpler manner. It consists of a galvanized tank *E* provided with a tube, soldered into it at the top, and another one at the bottom. These tubes are fitted with valves shown at *C* and *H*. The tubes are joined and are connected by means of a ⅜-inch hose *B* of any suitable length, say twenty feet, to a nozzle *A*. The nozzle should be provided with a quarter-inch aperture and a flared outlet. A bicycle pump *D* is connected with the tank



Gasoline and air tank for cleaning automobiles.

at one side and a pressure gage *G* is secured to the top. In use, a gallon of gasoline is poured into the tank, as indicated at *F*, and then the pump is operated to produce a pressure of several pounds in the tank. The valves *C* and *H* may now be opened to such an extent as to permit a small quantity of gasoline and a comparatively large quantity of air to flow though the hose and the nozzle *A* may be directed to spray the parts which need cleaning. A single gallon of gasoline and a few strokes of the air pump have been found sufficient to clean thoroughly a single automobile. This type of apparatus cannot compete in efficiency with that used in automobile shops, but it is a practical device for a private garage.

How to Make an Engine Crank

By Albert F. Bishop

THE task of making an engine crank is by no means beyond the abilities of the average amateur mechanic. The following directions will be found comparatively simple:

Take a piece of steel 2 inches thick, 5 inches wide and of a length to suit the purpose. A thin paste made of chalk dust and water may be spread over the metal and when dry it will provide an excellent surface for taking the lines of a sharp lead pencil. The crank may be laid out on this surface to the exact size required. The lines indicated in the accompanying

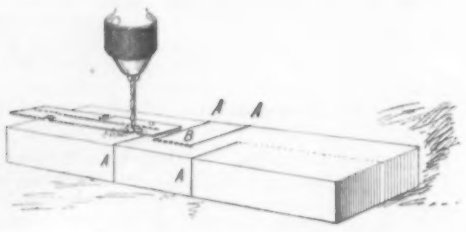


Fig. 1.—Cutting out a crank shaft.

drawing at *A* (Fig. 1) can be cut with a power saw. The cuts running lengthwise of the piece can be made to better advantage by drilling, although the two long cuts might be made by the power band saw. To facilitate the operation of drilling, a jig should be made of cold rolled steel, 1/16 inch thick, 2 inches wide and about a foot in length. Drill holes in this piece in a perfectly straight line, spacing the holes as close together as possible without letting one cut into the other. This jig need not be hardened unless a large number of cranks are to be drilled. The piece should be attached to the surface of the steel plate by means of three machine screws. Now, the workman can proceed with his drilling and if the holes have been laid out nicely in the jig, the steel can be separated without much trouble after drilling.

After the crank has been cut out roughly in this manner it may be centered on the ends and turned in the lathe. The tool should be sharpened with con-

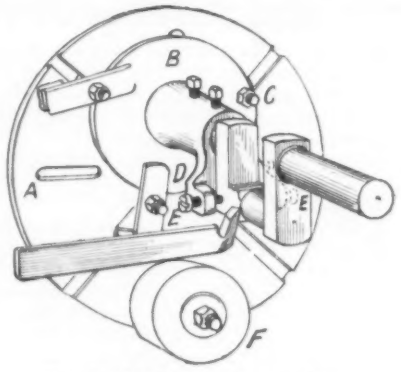


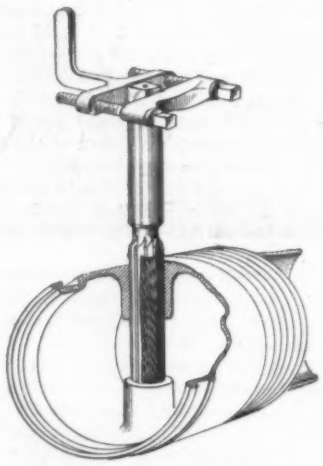
Fig. 2.—Machining the crank pin.

siderable bevel and made to cut deep but thin chips, taking off nearly the whole corner at the first cut. This procedure will do away with a great deal of knocking. The cranked shaft should be roughed out at first, leaving plenty of stock for the finishing cut. For turning the crank pin, make a flange of the form indicated at *B* (Fig. 2) with two ears at the outer end, as shown at *D*. The machining on this casting is simple. It consists in facing the flange and boring it out to receive the crankshaft. The flange is clamped to the face plate and a bolt at *C* acts as a pivot, so that adjustment up or down can be secured by tapping the piece lightly with a hammer. The straps are then bolted securely. Lateral adjustment is attained with two set screws indicated at *E*. Two more set screws will serve to hold the shaft firmly in the neck of the flange. A counterbalance *F* may be strapped or bolted to the face plate.

Enlarging a Reamed Hole

By R. P. Albert

WHEN a mechanic desires to enlarge by several thousandths of an inch a hole which has already been reamed with a standard reamer, he can readily do so by wrapping paper around the tool, covering about three-quarters of its circumference and



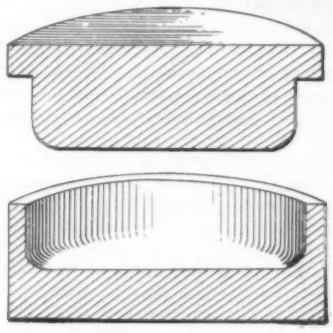
Enlarging a reamed hole.

leaving several cutting edges bare. The paper should be carried around with the reamer when the tool is in use. Graphite or the lead of a pencil should be rubbed on the outer surface of the paper to serve as a lubricant when the reamer is rotated.

A Leather Cup Die

By J. E. Noble

MEN who have much work to do around hydraulic presses know how annoying it is to find they are out of cup leathers just when they are in a hurry for one. The price charged for cup leathers by some dealers is out of all proportion to the material that is in the cup and the labor required to turn them out. The iron dies generally used to make cup leathers are also rather expensive. At one time it was part of the writer's work to keep several hydraulic presses in order. These presses worked under a pressure of 4,000 pounds to the square inch. The pistons were between 12 and 14 inches in diameter and over a foot long (solid iron), and leather cups were used on them. A set of dies was made out of hard wood. The illustration shows a sectional view of them. They were turned out on a lathe. The concave part was turned out to the size of the cylinder in which the piston worked, and the convex part was turned down to a diameter one-half inch smaller. The leather was cut to a diameter twice that of the piston plus twice the depth of the depression in the die. It was moistened in tepid water for a few minutes, and then pressed in the dies. With a heavy weight to provide the necessary compression the leather was left for several hours. A single pair of dies was used for two years, at the end of which time they were apparently as good as ever.

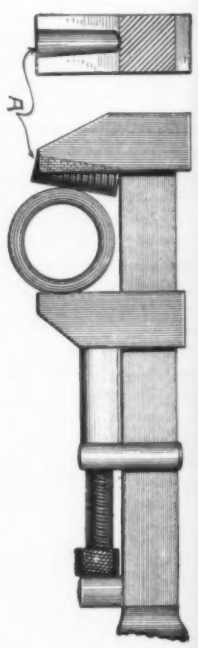


Wooden dies for cup leathers.

Combination Pipe and Monkey Wrench

A COMMON monkey wrench may easily be adapted for use as a pipe wrench for emergency work, thus making it unnecessary to carry two wrenches in the tool kit. Take an ordinary monkey wrench and mill a small groove in the fixed jaw, as shown at *A*. This groove should be milled on a taper as shown.

When the wrench is to be used on a pipe, take an old piece of bolt or stud, harden the threaded parts and place the stud in the groove that has been milled in the jaw of the wrench. This will prevent the wrench from slipping around the pipe while in use.



A monkey wrench used as a pipe wrench.

Workshop Notes

How to Weld Cast-Iron.—A good compound for welding cast iron is made as follows: 41½ parts boracic acid, 35 parts common salt, 20 parts ferrocyanide of potassium, 7 parts resin, 3 parts carbonate of sodium. Heat the metal to a light-red heat and apply the mixture over the part that is to be welded. Then heat to a yellow heat, and the welding may be done in the usual manner.—H. D. CHAPMAN.

Novel Method of Removing Broken Ax Handles.—A recent issue of Handy Man's Workshop contained a suggestion on removing a broken handle from an ax head. I think it can be done more conveniently in another way. When I break a handle, I fasten the tool head in a stump or some other place, take my shotgun and put the barrel about 2 or 3 inches from the plug in the ax. The trigger is then pulled, and no matter how hard the handle was fastened, it has to come. There is no danger that the shot will be reflected back to the gunner, even though it strikes the ax head.—H. T. PETERSON.

Progress of New York's State Barge Canal

By Nobert E. Whitford, Resident Engineer

WHENEVER the administrative heads of great enterprises change, the general public renews for a time its interest in the undertakings intrusted to their care, and when these enterprises have a national importance, the interest is intensified. So it is now with the New York State Barge Canal.

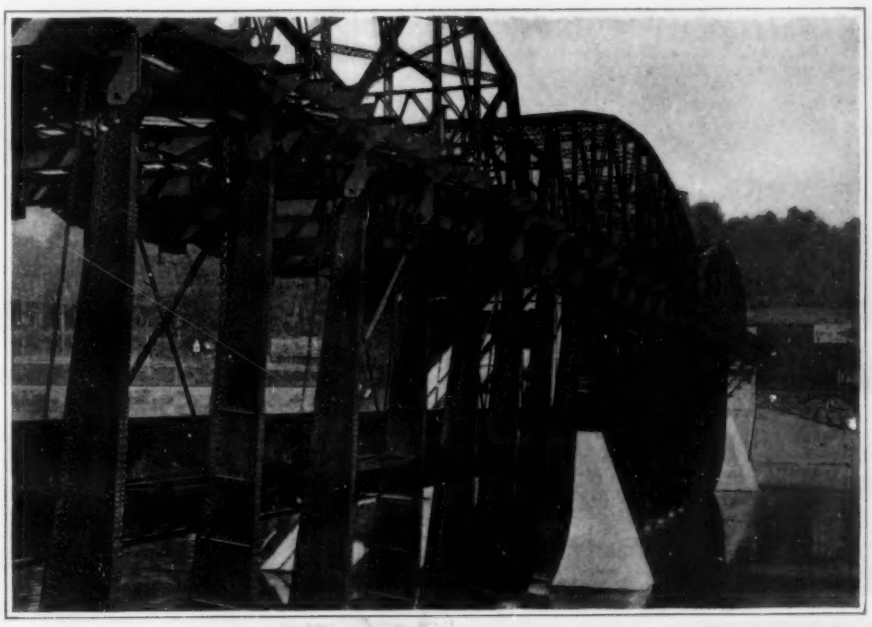
At the beginning of the year the incoming State Engineer found construction work on the barge canal improvement about one-third completed and contracts in force covering 96 per cent of the total mileage. He also found that, although most of the work was under contract, many of the contractors had been extremely dilatory, some of them having done very little, notwithstanding the fact that considerable time had elapsed since the award of their contracts. One feature in particular was found to be backward, a feature most essential to the completion of the project, namely, agreements with railway companies whose lines cross the canal, whereby the necessary bridges may be built or changes made.

As the general characteristics of the barge canal—its route, dimensions, number and kind of structures, capacity, cost and the like—have often been told before, they need not now be repeated. Rather it seems preferable to describe briefly some of the special features. By supplementing these descriptions with views of completed sections of the canal and other views of great structures under construction, or interesting bits of detail, a general idea of the undertaking should be conveyed.

At the opening of navigation last spring several of the new locks were so nearly completed that they were put in commission and have been in use during the past season. To maintain navigation on the existing canals, it has been necessary at certain localities to turn traffic into the new channels as soon as they were ready. Such a case has occurred at Oswego, where the canal enters Lake Ontario, and the lock at this junction is, perhaps, the most interesting of any along the whole line, for it is the first siphon lock to be built in this country and also the largest lock to which the siphon principle has ever been applied.

All of the locks on the canal are filled and emptied through culverts in the side walls, these culverts communicating with the lock chamber by means of lateral openings, termed ports. In all of the locks except the one at Oswego the flow through the culverts is regulated by gates, sliding vertically. In this lock, however, the culvert is curved and forms a neck above the top of the wall. To start the flow in this neck it is only necessary to exhaust the air; to stop the water needs but the readmission of air—a simple application of the well-known siphon principle. The interesting part is the device for creating a vacuum. This is a tank built in the wall and communicating by pipes with the upper and lower pools and by an air pipe with the top of the siphon. By filling this tank with water, then closing the upper pipes and opening the lower one, there is produced in the tank the effect of a body of suspended water tending to escape into the lower pool, thus creating the vacuum necessary for operation. The opening of a valve draws the air from the siphon to fill this vacuum, and this exhaustion of the air starts the flow of water through the culvert. At a certain stage the rushing water carries the remaining air along with itself and reverses the action of the tank, drawing back the air and reforming the vacuum, ready for the next operation.

The pipe for filling the vacuum tank is 12 inches in diameter, while the outlet measures 20 inches and the air pipe 4 inches. It readily appears, therefore, that all of these valves may be manipulated easily by hand, especially since the regulation of the 4-inch valves is all that is required, unless the leakage of air necessitates the refilling of the tank. This simplicity and economy of operation and of maintenance and the absence of steel work under water to deteriorate by rusting, together with a less cost for construction at this particular location at least, are the features that recommended this type of lock. Its use during the past season has not been disappointing. Two siphon locks are now being designed for the recently authorized addition to the barge canal system—the Cayuga and Seneca canal. The type appeared first in 1896 on a canal in Northern Germany, and since then others have been built at a few places in Germany, but it has characteristics that doubtless will commend it to an increasing use.



A movable dam of the bridge type

There is another novel type of structure that has recently been built on the canal, having been originated in its design, and this also employs the siphon principle. It happens that at certain places there are at times considerable quantities of surplus water that must be disposed of rapidly and yet the surface must not be lowered below a given point. To do this without the use of regulating gates and the accompanying cost of attendance, it is necessary to have some automatic device, usually a simple spillway with its crest at the required surface elevation. But cases have arisen on the canal at certain points where there was not room to place a spillway of sufficient length to pass the surplus. Hence the new type—designated a "siphon spillway." It consists of a concrete wall in which are left openings in the form of siphons. The intake is several feet below the surface of the body of water that is to be regulated, while the elevation of the outlet is governed by the depth of the stream into which the surplus is spilled, and the bottom of the neck reaches to the elevation at which the water surface must be maintained. As the neck is flattened to the form of a broad, low rectangle, with its top at the elevation to which the water may rise before discharge is to begin, the siphon is full when this point is reached, the air having been driven out by the water, and the siphon action becomes automatic. Air vents pierce the upper side of the wall at low-water surface and thus the stoppage of the flow is also automatic. A short spillway, or drift gap, to carry off floating debris, completes the structure. Two of these have been built and successfully operated.

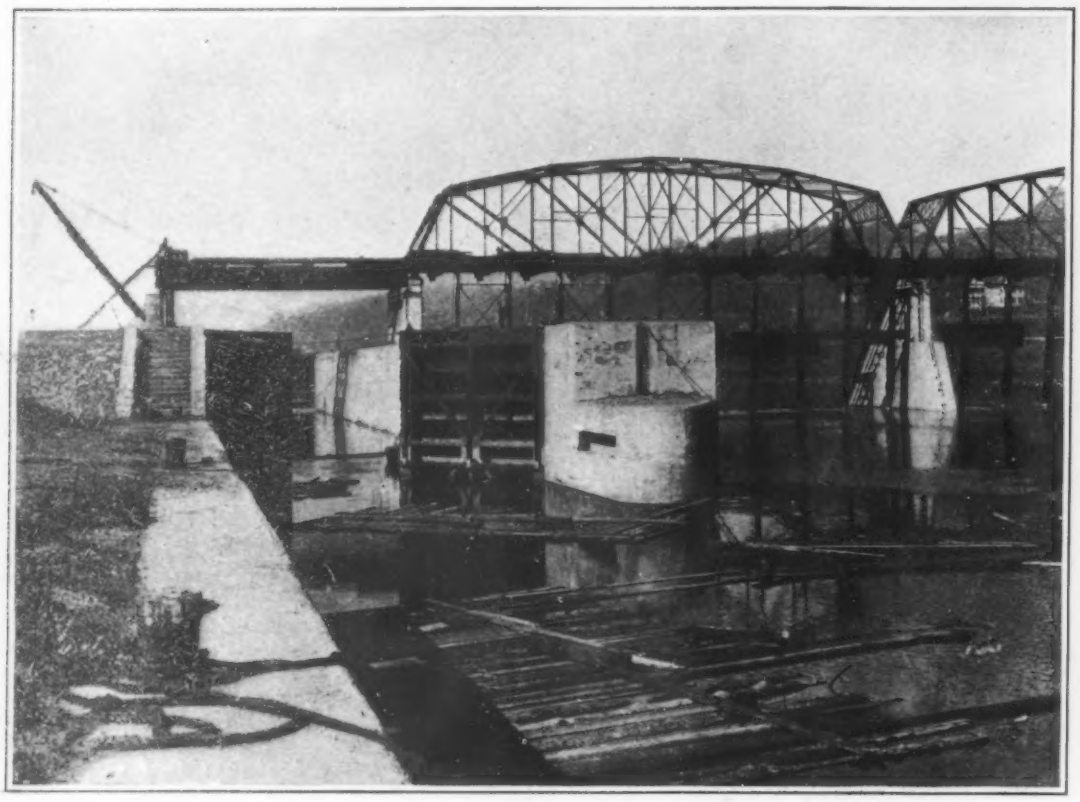
There are certain structures that have been in course of building on the lower Mohawk River for some two years, but not until recently have the outlines of their peculiar features become manifest to others than those immediately concerned. These structures are the locks and dams that are located at eight places between Schenectady and Little Falls. The peculiar features are embodied in the dams, for they are movable dams of the bridge type—the first to be built in this country. In constructing them it was necessary first to build abutments and piers, the same as for an ordinary bridge, and also to place a broad concrete sill in the bed of the river, extending between abutment and pier. After these operations, a bridge superstructure was thrown across, and then the distinguishing features were added—fabricated steel beams, suspended in pairs, 15 feet apart, and reaching from the bridge to the concrete sill. Upon these frames were then placed gates, of heavy steel plate, fitted with rollers for sliding on the uprights.

For convenience in regulating the stream the gates are divided horizontally in two tiers. When they are closed and the structure is in operation as a dam, the bottoms of the lower gates will rest on the concrete sill and the tops of the upper series will form the crest of the dam to govern the elevation of the water surface at ordinary stages. Whenever it is desired to permit the escape of more water than will spill over the crest, the gates are partially raised, one or all, and the water passes through the aperture thus provided. In time of extreme flood or during the winter season, both gates and frames may be entirely removed from the stream, leaving an unobstructed channel. To accomplish this the frames are attached to the bridge by a hinge-like joint, so that they may be swung up under the bridge floor to a horizontal position, carrying the gates with them. Steam winches, moving on tracks on the bridge floor, wind or unwind chain cables, to perform all of the work of operation.

A spectacular feature attending the building of the Barge Canal is a change in the map of the State that will add to its lakes two bodies of water of considerable size. These will impound a needed water supply, and are known at present on the plans as Delta and Hinckley reservoirs.

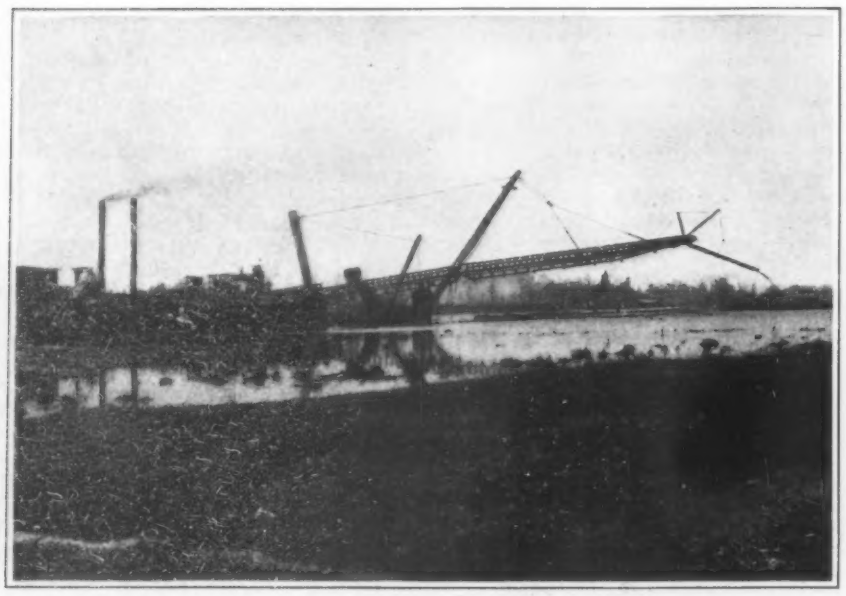
A profile of the canal across the State shows a continuous descent from Lake Erie to the confluence of Seneca and Oneida rivers, then a rise to the com-

(Continued on page 280)



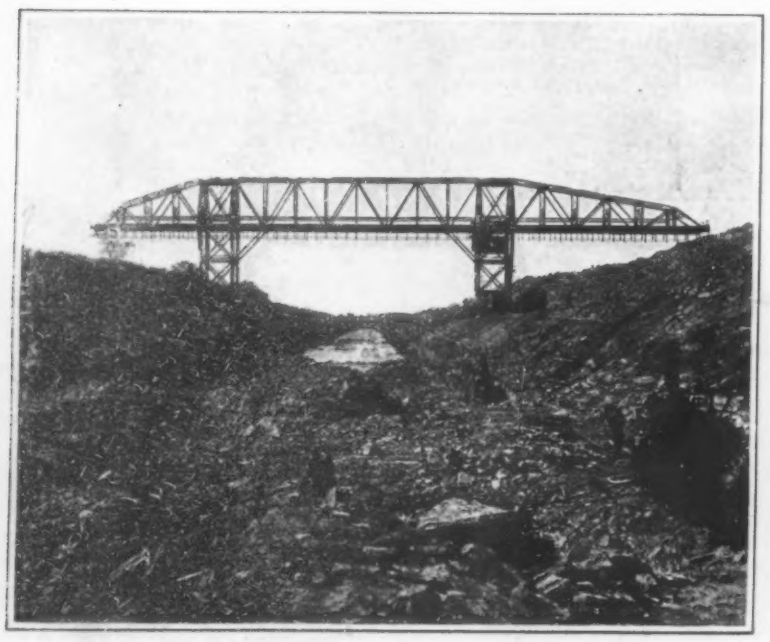
Typical lock and bridgework.

Tipple incline, used with steam shov

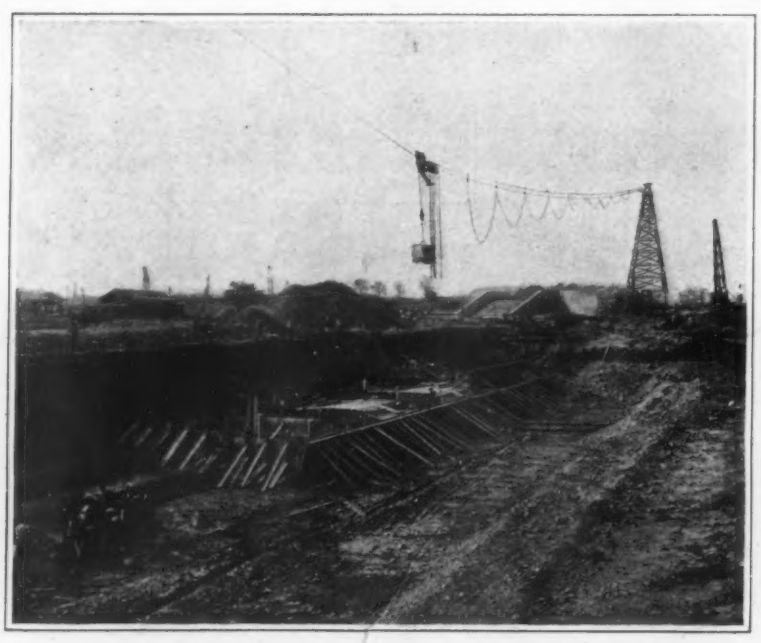


Shore delivery attachment to ladder dredge.

A cantilever excavator.



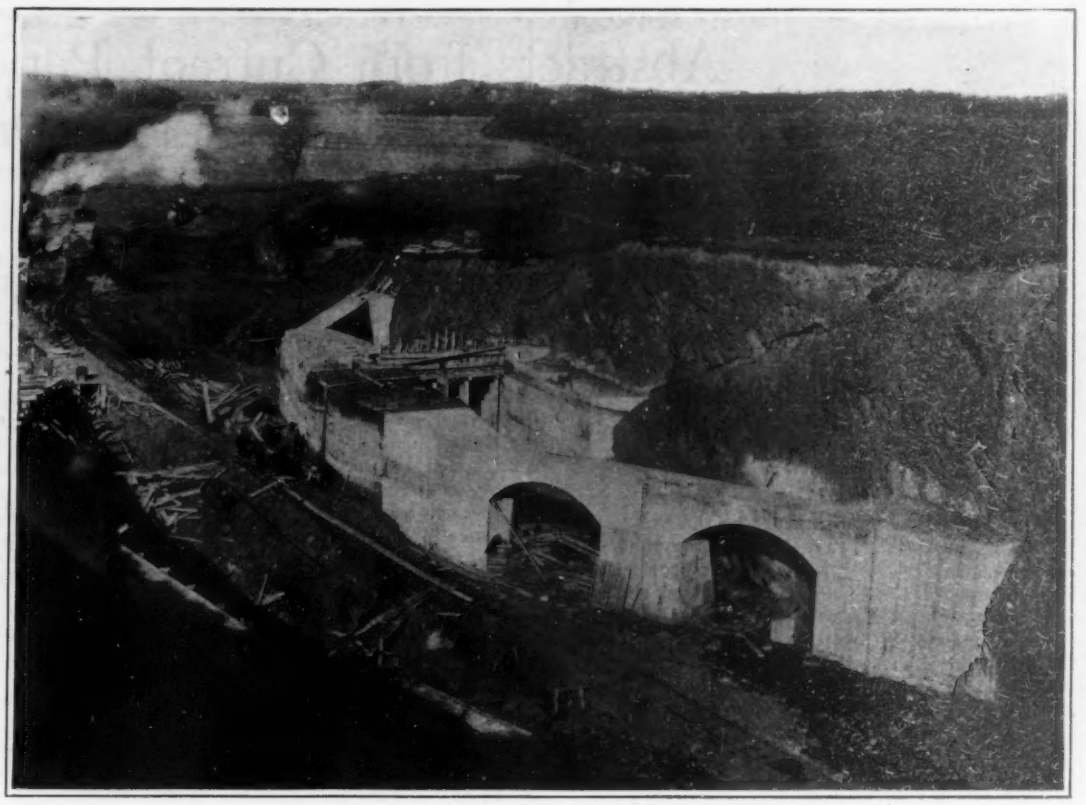
Bridge conveyor operating a 12 cubic yard clamshell bucket.



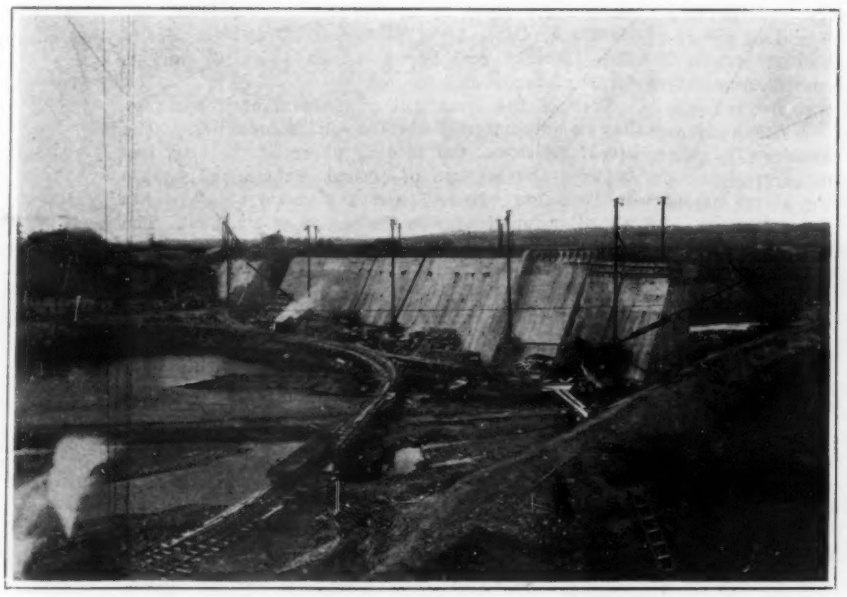
Cableway carrying concrete for building lock chamber wall.

A tower excava

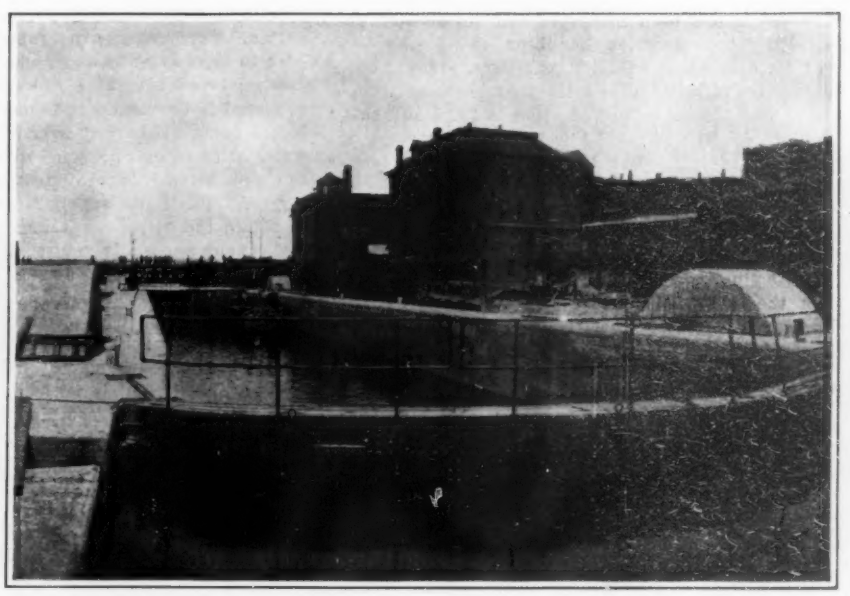
steam shovel to remove excavated material.



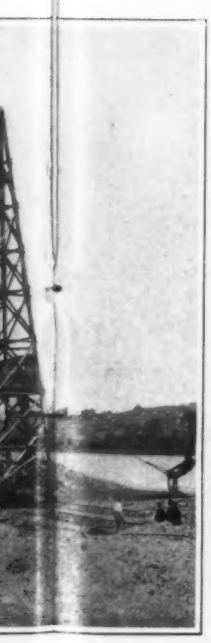
Guard-gate masonry at head of cut into Mohawk.



Dam at Delta-crest 100 feet above foundation.

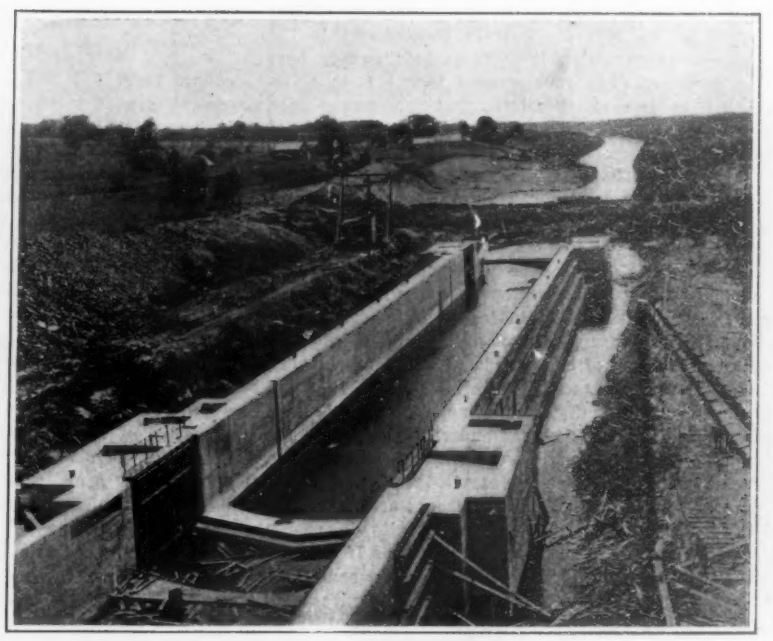


The siphon lock at Oswego.



wer excavator.

Crescent dam. (Note rock cut to Hudson in background.)



Lock, near Fort Edward, approaching completion.

K STATE BARGE CANAL

Abstracts from Current Periodicals

Phases of Science as Other Editors See Them

Sir William Ramsay's British Association Address

THE presidential address delivered by Sir William Ramsay before the meeting of the British Association for the Advancement of Science at Portsmouth was a novelty in its distinguished position, for it was discursive. In the opinion of the *London Lancet*, "Sir William Ramsay delivered an address which was generally retrospective, seeking to picture the present position of civilized nations politically, scientifically, socially, educationally, industrially, imperially, in contrast with periods of the past."

The *Lancet* regards as the most remarkable passages in his address those in which he referred to the position of the elements of radium and the wonderful manifestations of its energy. "From its physical and chemical properties radium is an undoubted element, but, as Sir William Ramsay observed, it is a very curious one, for it is unstable, and hitherto stability has been believed to be the essential characteristic of an element. Radium, however, disintegrates—changes, that is to say, into other bodies, and at a constant rate. If one gramme is kept for 1,760 years only half a gramme will be left at the end of that time; half of it will have given off other products. It yields a condensable gas—radium emanation—and besides evolves helium. Helium seems to be a veritable element, and radium emanation has been shown to be incapable of chemical union, but it has been liquefied and solidified in the laboratory of University College, London, and its spectrum has been measured and its density determined. The emanation has been called niton to recall its connection with its congeners, argon, neon, krypton, xenon, helium, and its phosphorescent properties. The atomic weight of niton is 222.4 and that of helium 4. The sum 226.4 is the atomic weight of the parent radium. But the descent does not stop there. Niton in its turn gives radium A and helium, radium A rapidly gives another solid substance, radium B, helium again accompanying the change. Soon a half of B gives place to radium C, but in this case no helium is evolved, only atoms of electricity to which the name "electrons" has been given by Dr. Johnstone Stoney. Radium C has a short life, for it changes into radium C^2, parting with helium atoms. In two and a half minutes, however, radium C^2 is half gone, parting once again with electrons and forming radium D, which is longer lived, its disappearance eventuating in radium E with apparently no discharge of electrons or helium. Radium E changes spontaneously into radium F, which is the substance to which Madame Curie gave the name 'polonium.' In 140 days, however, polonium in its turn is half changed into an unknown metal, supposed to be possibly lead. Then apparently a check to the rapid descent takes place, for lead within present human limitations, at any rate, is stable.

"But there is no reason why even the stable elements should not decompose when subjected to enormous strains. The virtue of the energy of radium consists, as Sir William Ramsay pointed out, in the small weight in which it is contained; energy here is in an enormously concentrated form. It is disappointing to be told, therefore, that the supply is a very limited one, and that it can safely be affirmed that the production will never surpass half an ounce in any year. The small quantities, however, which have been so far produced have afforded sufficient energy to induce the degradation of elements hitherto regarded as stable. The action of niton or radium emanation on salts of copper appears to show that the metal copper can be converted partially into lithium; and similar experiments indicate that thorium, zirconium, titanium, and silicon are degraded into carbon, for solutions of compounds of these, mixed with niton, invariably generate carbon dioxide, while cerium, silver, mercury, and some other metals give none. This is all a very wonderful story, and we may well ponder over the possibilities for the human race to which these discoveries are leading. Sir William Ramsay suggests that if elements are capable of disintegration, the world will have at its disposal a hitherto unsuspected source of energy. If radium were to evolve its stored-up energy at the same rate that gun-cotton does, we should have an undreamt-of explosive; could we control the rate, we should have a useful and potent source of energy, provided always that a supply of radium were forthcoming. 'If, however, the elements which we have been used to consider as permanent are capable of changing with evolution of energy; if some form of catalyzer could be discovered which would usefully increase their almost inconceivably slow rate of change, then it is not too much to say that the whole future of our race would be altered;' that is how Sir William Ramsay pithily sums up the position. A fuller account of his address will be found in this week's SUPPLEMENT.

Use of Cement Gun by the Government

THE "cement gun," a device for putting concrete in place by compressed air, is being used by the Quartermaster's Department, United States Army, in the Hawaiian Islands, and is proving of value in the construction of the ordnance shop at Fort Ruger. The apparatus was originally provided with a nozzle that became worn and clogged easily. These difficulties were overcome when Capt. Edwards, quartermaster, invented a rubber-lined nozzle that gave complete satisfaction. The following description of the device as used in Hawaii is furnished by Capt. A. B. Putnam, Corps of Engineers:

The cement gun is manufactured by a New York company, and consists of an air compressor, a 4-cylinder marine gasoline engine of 20 horse-power, a 1-inch wire-wound rubber hose with walls three-eighths inch thick for delivering dry sand and cement mixed, an ordinary garden hose for delivering water to the nozzle of the gun, and the gun or nozzle itself.

The nozzles originally furnished with the machine were not rubber lined and soon became abraded, so as to render them worthless. The nozzle used by Capt. Edwards, quartermaster, is lined with rubber (about three-sixteenths inch), so that no mortar sticks within. Furthermore, the rubber lining does not appear to become worn under use except very slowly.

A mixture (1 to 2½) of cement and fine sand is delivered to the nozzle at 30 pounds pressure, and just before being discharged is met by a circular spray of water at 30 pounds pressure within the nozzle, so that the wet mortar is projected on the surface to be covered. The water supply is regulated at the nozzle to obtain the correct consistency.

Triangular mesh is secured by staples to the studding of the structure, and is backed up by either heavy paper or wood placed so that the mesh will be in the center of a mass of stucco 1¼ inches in thickness when the spraying is completed. In dwelling houses the stucco is placed on the studding inside as well as outside, but is made only about three-fourths inch thick inside. Smoothing is done by shooting a fine light spray of wet mortar. No finishing is done with the trowel. The finished surface inside is to be painted. The resulting stucco is very hard and makes a fair appearance, though it is necessarily rough. So far, provided the mesh is placed so that edges overlap, I have observed no cracking. It should be noted that this stucco is merely a thin wall of plaster, and bears no strain except that due to its own weight.

When stucco is placed inside and outside, the paper backing (10 pounds per 100 square feet) is left in the wall. When only an outside is placed, the wood or paper backing is removed when the stucco has hardened.

At this date of writing one gun is placing 90 square yards, 1¼ inches thick, per working day. The cost at present, including cost of studding and backing in place, is $1.13 per square yard.

The hose now in use is stronger and heavier than the one supplied with the outfit, and the nozzle is different, being about 12 inches long, as against about 4 inches as supplied, and being rubber lined throughout, so that the mixture never touches metal. There has been but little work done here as yet, so that cost data are not complete, and it has only been since Capt Edwards applied a new nozzle that the gun worked well.

Tests are to be made by the Isthmian Canal Commission to determine the value of cement mortar, applied to iron plates by the "cement gun," as a preservative of iron at Panama. Twelve plates, 63.8 by 14 inches, have been coated with a 1 to 3 mortar of cement and sand, after they were cleaned to gray metal by the sand-blast process. Six of these have been covered with a ½-inch coating, and the remaining six with a 1-inch coat on one side, and a 1½-inch coat on the other. Three plates of each kind have been sent to Balboa, and three to Cristobal, where they will be kept immersed in salt water to test the mortar method of preventing corrosion. Two plates of each kind will be taken from the salt-water bath at the end of three months, and one-half of the coating will be removed to determine the condition of the metal. The duration of the test for the balance of the plates will be determined later.

Aviation in Japan

IN the *Deutsche Zeitschrift für Luftschiffahrt* Dr. Demcker reviews the history of aviation in Japan. Although the art of making kites has been cultivated in that country from time immemorial, and the man-lifting kite—the precursor of the modern aeroplane—was, according to tradition, utilized by a banished daimio to send a message to his vassals in the year 1156, Japan has been slow in taking a share in the great recent development of aviation, as well as of other branches of aeronautics.

Two years ago, however, the Japanese government sent two army officers to Europe to study aviation, viz., Capt. Hino to Germany, and Capt. Tokugawa to France. These officers, besides making themselves proficient in the art of flying, purchased on behalf of their government a number of aeroplanes of various makes—Blériot, Wright, Grade, Farman—and have now returned to Japan, where they are giving instruction to a number of other officers. For the purpose of these lessons the government has established a large aviation field about two hours' journey by railway from Tokyo.

The government has also organized an official society for the study of aviation, its members all being government employees, including military and naval officers and professors in the imperial university. A grant of $375,000 has recently been voted to this organization.

The Japanese are not entirely dependent upon foreigners for their flying-machines. Capt. Hino, Dr. Narahara, Capt. Isobe of the navy, Messrs. Morita and Tsutsuki, and Baron Iga have devised various forms of aeroplane.

Each of the important newspapers of Tokyo now has a department devoted to aeronautics. The *Hochi Shimbun*, the leading paper of the city, has engaged the services of Messrs. Takata and Inouye as "aviation editors," and the *Asahi Shimbun* has a similar functionary in the person of Mr. Usui. The semi-official journal *Kokumin* has offered a prize of $5,000 for a flight over the Bay of Tokyo.

"Stalloy"—An Iron Alloy of Peculiar Electrical and Magnetic Properties

PARTICULAR attention has been given to "Stalloy" by many investigators on account of the claims made by its inventor (Hatfield) with regard to its magnetic properties. A paper on this subject, embodying the results of a research carried on by H. R. Hamley and A. L. Rossiter, appears in a recent issue of the Proceedings of the Royal Society of Victoria. The principal facts and conclusions given by the authors are very briefly summarized below:

"The special feature of 'Stalloy' is its high specific electric resistance and high permeability. The specific resistance being about four times that of the best transformer iron, the eddy-current loss for a given thickness of sheet would be greatly reduced, so that lamination need not be carried out to anything like the extent necessary with ordinary iron, and the question of insulation of laminæ becomes less troublesome. It is more expensive than ordinary iron, but the increased expense is compensated by a reduction in size of the transformers, etc., constructed of it, an increase in output, and greatly improved efficiency.

"The special chemical feature of 'Stalloy' is that it contains about 3.4 per cent silicon. The value of this alloy is emphasized in a paper by Epstein, where several tests of its properties are given.

"Several investigations have been made by other experimenters by direct current methods, which agree fairly well together.

"The object of the research was to investigate the magnetic properties of 'Stalloy,' not only with direct current, but also with alternating currents of varying frequencies.

"Summing up generally, it may be said that the chief results to be noticed are that—

"(1) 'Stalloy' cannot be used to advantage in the unannealed condition.

"(2) In the annealed state the results obtained fully bear out the claims made by the makers, the permeability being very high and the losses small, particularly the eddy-current loss.

"(3) The results slightly differ from those of other experimenters, the permeability being generally a little lower in our results than in theirs.

"(4) 'Stalloy' behaves very much like ordinary iron under varying frequencies.

"(5) The constancy of the value of the hysteresis loss for different frequencies is remarkable."

The Inventor's Department

Simple Patent Law; Patent Office News; Inventions New and Interesting

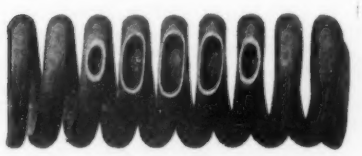
Oddities in Inventions

A Novel Milk Bottle.—When unskimmed milk is delivered to the consumers in the usual type of bottle, the cream forms a layer floating on the milk. In pouring out the contents of the bottle they are necessarily more or less disturbed and mingled. To provide a bottle that shall be free from this defect is the purpose of recent patents here illustrated. The device is extremely simple, resembling in general outline the customary milk bottle, from which it differs by having a lateral neck formed about the point where the

Milk bottle with a cream tap.

bottle reaches its largest diameter. Through this neck a curved tube of glass, paper or other suitable material is inserted, being free to slide in and out a certain distance, or to rotate about its axis. Both necks are closed with paper lids in the usual way. The operation of the device is so straightforward as to hardly require explanation. When it is desired to draw off the top layer of the cream the curved tube is turned with its inner end directed upward. If cream from a lower layer is required, the tube is turned accordingly. In transit, the tube is pushed in as far as it will go, to protect it against injury.

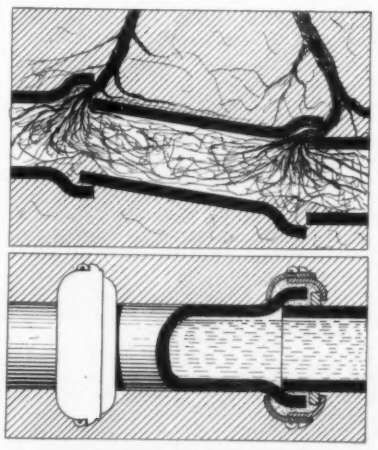
Tubular Springs.—Everyone is familiar with the fact that for a given weight a tubular rod has much greater rigidity than a solid bar, and the use of such tubular members in bicycles, automobiles and airships is a matter of common knowledge. No one, however, seems to have thought, until quite recently, of employing tubes in the construction of springs. A series of experiments carried out at the laboratory of Arts and Crafts (France) has shown that tubular springs of the construction shown in our illustration give



Tubular coil spring.

every satisfaction and possess many advantages, as is pointed out in "La France Automobile et Aerienne." As regards weight in particular, the economy gained varies somewhat according to the dimensions, ranging from about 40 to 60 per cent. But this is not by any means the only advantage. The smaller mass of the spring implies less inertia, with the result that the spring obeys more promptly the impulses which it receives. This is of importance where the spring is required to take up sudden jerks or rapid oscillations. Another effect of the small inertia of the spring is that an impulse communicated to one end of it is very rapidly propagated along its whole length, whereas in the case of a massive spring it is apt to be taken up by the first two coils alone, which are thus placed under severe strain and may be ruptured. Still another advantage is that, in view of the slight thickness of the material, it can be more thoroughly tempered. Among the applications which suggest themselves for the new tubular spring, the first that occurs to one's mind is its use for the alighting members of an aeroplane, in which it will replace the usual rubber bands. So far as weight is concerned, there will be a slight advantage in favor of the tubular spring; as regards working efficiency and durability, the tubular spring is far ahead of the rubber band. The theory of the tubular spring follows along the same lines as that of the tubular rod. As is well known, it is the outer fibers of a rod which are placed under the greatest strain in bending, while the central fibers are practically unstrained. Thus the tube is obviously the most advantageous form for a member which is to sustain bending stresses, inasmuch as all the peripheral fibers, that do the main work, are present, while the central fibers, which are comparatively useless and merely add ballast, are simply eliminated.

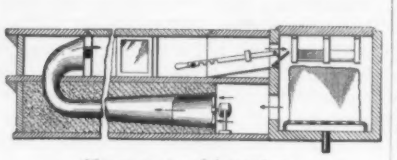
Root Shield for Sewer Pipes.—In their search for moisture the roots of trees are very apt to work their way between the joints of sewer pipes, eventually obstructing the pipes to such an extent that they are completely clogged. Then it is necessary to tear up the ground and cut away the roots, for it is impossible to clear the pipes in any other way. This trouble is due, of course, to the fact that sewer pipes are ordinarily loosely telescoped, which results also in leakage at the joints. To protect the pipes against roots, an inventor has recently devised a guard, consisting of two telescoping shield mem-



Sewer pipes protected and unprotected from roots.

bers, adapted to fit over the joint. The flared end of one of the pipes serves as an abutment for one of the shield sections, while a lead ring serves a similar purpose for the other shield section. The space enclosed by these sections is filled with cement. The two shield members are coupled by means of cross pins, fitted through ears in one member and bearing against lugs in the other. The accompanying drawing shows a guard in section as well as an exterior view. It also shows the effects of the roots on an ordinary sewer pipe.

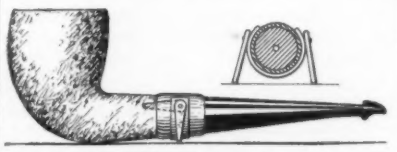
Refrigerator for Show Cases.—With a view to displaying meats and other provisions in a show case, while keeping them fresh and in a wholesome condition, an inventor has devised a novel form of refrigerator. The accompanying sketch shows a sectional view of a portion of a show case equipped with this system. At the right hand end is the refrigerator proper, consisting of a box provided with a perforated tray or rack, on which a block of ice may be supported. A large port connects this icebox with a com-



Show case refrigerator.

partment below the showcase proper, and here a fan is provided, which serves to drive air through a tube leading to the opposite end of the show case. A constant circulation is had by providing a port to connect the show case with the upper part of the refrigerating box. The arrows show the course of the air. The inventor has found that by this means he may cool the meats in his show case sufficiently to cover them with a coating of frost even in warm weather.

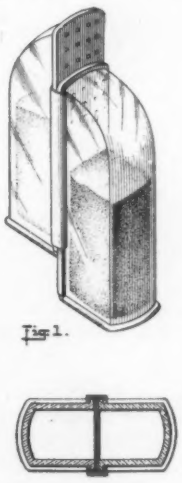
Rest for Tobacco Pipes.—One of the disadvantages of the ordinary tobacco pipes is the fact that it cannot be laid down without danger of spilling the tobacco ashes, and there is even the possibility of accidentally setting fire to material coming in contact with glowing embers of tobacco. To prevent such conditions, a Canadian inventor has designed



Rest to hold a pipe bowl upright.

a clip adapted to grasp the stem of the pipe and provided with legs which will support the bowl of the pipe in an upright position. These legs may be folded against the stem when desired. Instead of employing a clip, he also provides a ferrule or sleeve, equipped with supporting legs, which may be used to connect the stem with the mouth-piece.

Combined Salt and Pepper Shaker.—An inventor has recently hit upon a scheme for combining salt and pepper shakers in such a way that one will act as a cover for the other so that each condiment will be kept in an inclosed receptacle, in which no moisture may normally enter. Each receptacle is complete in itself but is connected to the other by a pair of channel-shaped plates which engage flanges on the meeting edges as shown in the cross-



Combined salt and pepper shaker.

sectional view, Fig. 2. Salt or pepper may be shaken out of this combined receptacle on sliding one member upon the other so as to uncover a set of perforations in the face of the compartment from which the desired condiment is to be taken. Figure 1 in our drawing illustrates the shakers moved to such position. After one has helped himself to a quantity of salt or pepper he cannot stand the shaker upon the table with the parts in the position illustrated, for they will not hold their equilibrium. In order that the shaker may stand upright, the two members must be slid back to normal position, so that each will rest on the table.

Machines for Dealing Cards.—Two machines for dealing cards are described in a recent issue of *La Nature*. One of these devices, which is extremely simple, is represented in Figures 1, 2 and 3. The pack of cards is placed in a box *B* (Fig. 1), which it fits exactly and which is open at one end. A rubber wheel *R*,

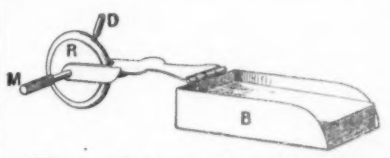


Fig. 1.—Hand-operated card dealer.

turning on an axis one end of which, *M*, is fluted so that it can easily be turned with the fingers, is brought to bear upon the cards by turning the hinged arm which carries it. When the

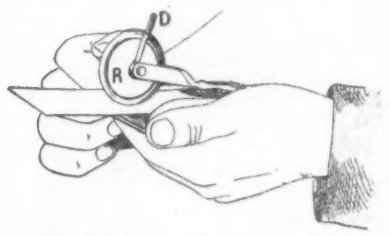


Fig. 2.—Dealing a card.

wheel is turned in one direction, as shown in Figure 2, it expels the top card; when this object has been effected the motion of the wheel is stopped by the impact of the arm *D* upon the pack

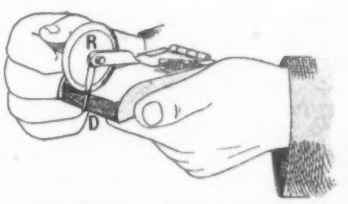


Fig. 3.—Resetting the cards.

of cards. The wheel is then rotated in the opposite direction (Fig. 3) until the arm *D* strikes the edge of the box. This reverse motion serves to replace any of the upper cards which may have been dislodged slightly in dealing the first card.

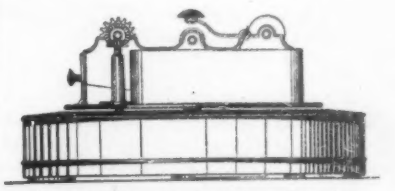


Fig. 4.—Power-operated card dealer.

The operations above described are repeated for each card. With a little practice cards can be dealt very quickly and thrown to a considerable distance. When the front of the pack is pointed slightly upward, the cards turn in the air before falling, but if the direction of

the pack is slightly downward the cards do not turn. Hence the cards can be dealt with their faces up or down, at will. The other machine, the invention of J. Olivier, is automatic and much more elaborate. It is designed especially for the games of bridge and whist, but it can be adapted to other games, using packs of 32 or 52 cards. The machine (Fig. 4) works silently and occupies little space. It is wound up with a key for a certain number of deals, 10 or 12, and a bell gives warning that the machines must be wound up after the next deal. A circular base, resting on rubber feet, contains the clock work and supports a rotating platform on which the cards are placed. The platform is turned by a ratchet wheel, a quarter-revolution at a time, and at the end of each motion a rubber cam projects the top card in the direction of the player. The apparatus stops automatically after each deal. It is started by placing the cards in position and pressing a button.

Notes for Inventors

New Vacuum Cleaners.—A vacuum cleaner operated by gas is a new thing for which one great advantage is claimed and that is that it destroys the dirt which finds its way into its interior. Thus it is not necessary to empty the machine. It is not designed to be portable but to be built into the cellar of the house with pipe connections with each floor. It is only necessary to start the engine which is like any small gas engine and very simple to manipulate and then to make the necessary connection with the hose at the point of operation. The dust taken from the floor returns to the machine, where it passes through the flame and is entirely destroyed, the dust passing up the chimney with the exhaust of the engine. In the creation of the vacuum, superheated steam is used. Water is fed into a coil through a needle valve and as it drops from the point of entry, it is turned into steam and finally into superheated steam. The latter is then carried through a curved pipe and forced through a small nozzle into a cone shaped chamber. The action of the steam in rushing into the chamber forms the vacuum. The force of this is said to be sufficient to lift an ordinary building brick and hold it in mid-air. Another of the recent improvements in vacuum cleaners is one which is worked by the water power secured from an ordinary faucet. The device is designed either for portable use or stationary installation. The machine weighs but twenty-two pounds and may be readily carried around the house and placed wherever there is a convenient water outlet. A short tube connects it with the water pipe and a longer one of non-collapsible rubber permits the application of the vacuum at the desired point, remote from the machine. In the handle of the apparatus there is an observation glass for the purpose of watching the work. The machine is successfully operated by a pressure of fifteen pounds which is available in most all water systems. One of the newest features for the convenience of the automobiler is a small vacuum cleaner which is operated by the exhaust from the engine and this is useful not only in the cleaning of the interior of the car but also in removal of the accumulation of dust from the clothes of the passengers after a long ride.

A Pocket Camera.—It is always the big fish that get away and the big game that is encountered by the would-be sportsman when he is without his gun. So the camera worker realizes that he misses many desirable views and snapshots because these opportunities are met with at times when he is minus his camera. Even as compact as these instruments have been made by modern ingenuity it is not convenient to have one's camera always in hand. Hence many excellent views are lost, for it is generally impossible to return to the spot on another occasion and find the same combination of elements which goes to make up a desirable composition. The newest arrival in the camera field is a really and truly vest pocket one, and in such a shape as this the photographer may never be caught unawares. It is not a toy, but designed for serious work. It makes use of either plates or cut films measuring one and three-quarter inches by two and a quarter. These are carried in holders. The instrument is fitted with a fine lens and the pictures made are of such a character that they will stand enlargement up to six and a half inches by eight and a half under all ordinary circumstances; but if the original negative is made under favorable conditions, the enlargement may be greater. While direct prints make very pretty pictures, it is designed that generally enlargements shall be made. For this reason an enlarging machine has been designed for the special purpose of making prints from these negatives. It is so complete that enlargements may be made quite as readily as direct prints. The camera is made in two parts, one carrying the lens and the other the plate. These two are held together by the bellows and a spring hinge. When the parts are collapsed the whole forms a small and compact package which readily slips into the pocket. In fact, the whole outfit complete takes up but little room in the traveling bag or in an emergency could be carried in two pockets.

Young Stokes Takes Out a Patent.—William E. D. Stokes, Jr., of New York city and George W. Davis of Galilee, N. J., assignors to W. E. D. Stokes of New York, have secured a patent, No. 1,001,227, for an aerial for wireless telegraphy and telephony and 1,001,228, for a receiving circuit in the same art. The aerial patent provides two vertical points of support with a wire between them and a series of vertically arranged wires standing in a plane and a switching device by which any of the aerial wires alone can be connected to the receiving circuit. The receiving circuit includes a large copper plate connected to the aerial and embedded in insulating material and supported parallel with the ground by insulating standards.

A Barbed-wire Improvement.—In the manufacture of barb-wire, which is turned out in great quantities, it has been heretofore necessary to make use of a double strand of wire, the two being twisted and the sole use of the extra strand is for the purpose of holding the barb in place. A new machine for the manufacture of this article has been recently perfected by which the barb is pressed in place firmly around a single wire. This saves wire in two directions, namely, in the use of the extra strand and in the cutting of the barbs, the latter being twisted only once, while formerly they were given a double twist. The new machine also has the advantage of increased speed and economy of operation.

Stopping Trains When the Motorman is Killed.—Trains of the Interborough lines and those of the Hudson tunnel are being equipped with a safety device which overcomes the possibility of a train running wild when the engineer is killed, injured or otherwise incapacitated. It consists of an electric button which is placed in the handle of the controller and normally, when the operator is at his post, this is in a depressed position, but the instant his hold on the handle is released for any cause whatever an electric circuit is made and the brakes of the train are set.

Erratum

IN our issue of September 16th we published an article entitled "Inventing for the Public." Among the portraits of the government officials who had given their inventions to the public, appeared those of L. W. Page, director of the office of Good Roads, and J. E. W. Tracy. Through an error Mr. Page's name appeared below Mr. Tracy's portrait, and Mr. Tracy's name appeared below Mr. Page's.

RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

GARMENT FORM.—E. T. PALMENBERG, New York, N. Y., and F. W. KREUSCH, Bayonne, N. J. In this form the arm pieces can be readily removed for fitting purposes, at the same time showing a correct armhole outline. The arm pieces are provided with armhole patterns, of which one has a tongue for engagement with a keeper on the other pattern, to removably connect the arm piece with the shoulder.

SHOE SHINE PROTECTOR.—R. B. LUTHER, Pipestone, Minn. The purpose here is to provide a novel one-piece self-closing protector which will cover the hose adjacent to the shoes while the latter are being cleaned, polished or shined, thus preventing the soiling of the hose. The protector may be used for both low and high shoes.

Of General Interest.

LIFE PRESERVER.—J. STROBEL, New York, N. Y. The main feature of this invention involves the automatic closing of a normally open air inlet valve by the securing of the life belt in position upon the person. The belt is mechanically distended when being strapped on, and this distension draws air into the air chamber, and then automatically closes the air inlet valve, to prevent the escape of the air or the entrance of water.

METAL FRAME FOR GLASS PANES.—A. BUSSE, New York, N. Y. The object of the present invention is to so join the bars that no unfilled openings or protuberances will be presented at the points of intersection in the finished frame, producing an interlocked frame structure of relatively high strength. The invention is an improved metal frame for glass of the character disclosed in Letters Patent No. 942,611 formerly granted to Mr. Busse.

PROCESS OF REFINING AND DESILVERING LEAD.—G. P. HULST, Omaha, Neb. This improvement relates to refining and desilvering by the crystallization process. The aim is to provide a method for refining and desilverizing lead bullion and impure lead, and whereby the number of crystallizing operations is reduced to a minimum for the proper production of high grade bullion or metal running five hundred to six hundred ounces silver and a market lead.

OAR LOCK.—F. D. STARIN, Whitewater, Wis. The object of this inventor is to provide a device to permit of oar lock adjustment to counteract the effects produced by wear. Another object is to provide a device of simple and serviceable construction, inexpensive to manufacture, which is adjustable so as to render the oar locks practically noiseless while in operation and also to overcome lost motion occasioned through wear.

NON-REFILLABLE BOTTLE.—S. O. STANICH, Anaconda, Mont. In this case if any attempt is made to force a liquid down into the bottle the pressure will cause the thin glass strip which holds a valve and ball to break, thereby permitting the valve to seat against a valve seat while the ball will roll to the bottom of a conduit, breaking a thin glass partition and will seat itself on another valve seat, which prevents any liquid from the outside from entering the bottle.

ATTACHMENT FOR SUIT CASES AND THE LIKE.—L. SPIRO, Clarksburg, W. Va. An object here is to provide a device by means of which that portion of the suit case upon which the lock is situated may be effectually braced, so that when the lock is sprung together it may have a resisting part which prevents the bending of the side of the case and, hence, the failure of the lock to work.

CUTTER FOR WELL CASINGS.—H MEAD, Coalinga, Cal. Mr. Mead's invention is a cutter for use in removing the casings of oil wells and the like when for any reason the whole string of tubing constituting the casing cannot be pulled. It comprises a supporting head in which is mounted a series of cutter wheels and cutter knives, the number of wheels being equal to the number of the knives in each case, and all the knives and disks being located in the same transverse plane.

SHIP OR VESSEL.—G. E. ELIA, Hôtel de Crillon, Place de la Concorde, Paris, France. This invention relates to ships or vessels and is particularly applicable for use in connection with vessels employed in naval warfare, the object being to preserve the stability of the same in the event of their being subjected to the effects of a submarine explosion. This application is a divisional application of one filed formerly by Mr. Elia, the serial number of which is 568,304.

Heating and Lighting.

GAS GENERATOR.—C. F. RUKES, Kansas City, Mo. The hopper in this generator is filled with carbid, and the casing is supplied with water. Whenever the gas in the casing does not exert sufficient pressure to push the diaphragm outwardly, the free end of the switch lever falls between contact bars and closes the circuit, thus energizing the magnets. Means provide for shaking off some carbid into the water, which generates pressure and opens the circuit. Means are also provided for preventing any great amount of carbid from leaving the hopper. Thus the operation is entirely automatic and a practically constant pressure of gas is maintained.

Household Utilities.

COMBINATION COVER AND DISH DRAINER.—H. GREASON, Ridgewood, N. J. The object in this instance is to provide a new and improved combination cover and drainer, more especially designed for use on wash tubs located along the sink or a similar receptacle, the device being arranged to permit its use as a cover for the wash tub or as a drainer for the dishes.

CLOTH FOLDER FOR IRONING.—H. C. RAND and M. M. GRAF, Cresco, Iowa. This device is for use in folding the edges of cloth, strips, or ribbons when being ironed or pressed. The device will operate to fold the edges of the cloth, and also to form a seat for the edge of the iron, enabling the device to be guided in its movement along the strip, cloth, or ribbon.

CLOTHES LINE CLAMP.—W. C. LEA, Chickasha, Okla. The object here is to provide a device which may be easily placed and removed, and which may be locked on the line with or without clothes thereon, and which may be easily and cheaply constructed. When not in use the clamp may be clamped on the line or may be removed if desired. When clamped on the line, the clamp is retained firmly in position and cannot become loose.

Machines and Mechanical Devices.

DISSOLVING VIEW APPARATUS.—H. KRIEGER, New York, N. Y. This invention has reference to optics, and its aim is to provide a dissolving view apparatus, arranged with a single source of light and one lamp casing, thus simplifying the construction of the apparatus and requiring less adjustment and attention on the part of the operator.

DRILLING DEVICE.—R. R. SANDERSON, Orrville, Ohio. An object of this inventor is to provide a device of the walking beam type in which the rapidity of the operations of the drill rod may be considerably increased without sacrificing its effectiveness in any particular, thereby rendering the machine capable of doing more work in a given time than the ordinary drilling device.

ROCK DRILL MAKING AND SHARPENING MACHINE.—M. MCHALE, Phœnix, British Columbia, Canada. This invention provides means for shaping through successive operations the heads of drills as desired to provide means for varying the dies for forming the said heads; provides a sharpening and setting mechanism which may be rapidly and easily varied as to size and design; provides a battery of guiding members to operate in conjunction and unison with the sharpening and setting devices carried by the sharpening mechanism; and provides a machine with an adjustable anvil having a plurality of pockets to hold drills of varying lengths.

VENDING MACHINE.—C. J. PFOHL, San Jose, Cal. This machine is for use in dispensing small vest account books or the like, which upon the insertion of a specified coin will deliver a single book, and wherein an efficient means is provided for preventing its operation without the insertion of the proper coin, and wherein the coin is utilized to restrain the operation of the said means.

FOLDER FOR SEWING MACHINES—C. E. MCLIN and J. S. BACHMAN, Rome, Ga. The machine provides a folder suitable for folding cloth in making back bands. The invention comprehends an improved type of mandrel made in two massive parts detachably connected together and so formed that when a piece of suitable material is guided through this mandrel, the material is folded properly to be sewn by the machine and thus made into a back band.

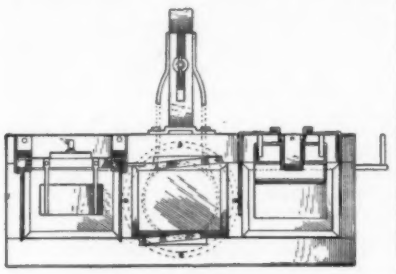
FRICTION CLUTCH.—F. D. OGDEN, Boston, Mass. An object of this invention is to provide a device extremely sensitive in its operation and unaffected by oil. Also to provide a plurality of members adapted to be driven one from the other, one of said members having a plurality of spring contact members adapted to be forced into engagement with a clutch face on the other member.

DUST PROOF STEM AND SLEEVE.—D. W. SHEPHERD, Pocatello, Idaho. This improvement refers to open face watches, and its purpose is the provision of a new means for rendering the watch case dust-proof at the stem, to allow convenient adjustment of the stem for winding and setting purposes, and without danger of end shake or breaking.

PROPORTIONING WEIGHING MACHINE.—R. M. CARDWELL and J. B. THOLEN, Terrell, Texas. This invention provides a plurality of measuring mechanisms arranged to automatically suspend the delivery of material thereto; provides an electrically-operated means for dumping one or more of said mechanisms simultaneously; and provides means whereby the number and combination of the weighing apparatuses may be regulated and controlled.

TYPE WRITER ATTACHMENT.—J. B. VIDAL, New York, N. Y. This invention relates to an attachment whereby the operator is aided in operating the typewriter by the touch "system." A further object is to provide a frame which will divide the various rows of keys into aisles by means of suitable partitions, and which will further sub-divide the aisles into tiers by means of stops, whereby the operator's hands are automatically pointed to their position relative to the keys of the typewriter.

MAGIC LANTERN.—ARTURO PAOLI, South Range, Mich. This invention is an improvement in magic lanterns and a front view of it is shown in the accompanying engraving. The object of the invention is to provide a simple and easily operated mechanism for shifting the picture slides in devices of the character specified, and in such manner that

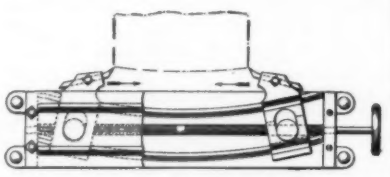


MAGIC LANTERN.

the pictures will merge into one another without any abrupt demarcation between them. As shown in the illustration, the device extends upon both sides of the projector, so that there is space for a slide in front of the projector and space for a slide on each side of the projector. A magazine is provided for use in receiving the used slides and for temporarily storing them.

AIRSHIP.—T. M. CREPAR, Dilworth, Minn. Mr. Crepar's invention pertains to airships, and its object is to provide one with a plane, the sides of which converge rapidly at its forward end, said sides converging slowly toward the rear, thereby forming an elongated tail, making the plane substantially fish-shape. Another of the objects is to provide two planes, one disposed above the other, there being central openings in each of the planes, and a series of vanes being disposed in each of the said openings.

WHEEL TURNING DEVICE.—WILLIAM CUSHING, Claysville, Washington County, Pa. In the present patent the invention has reference to turning, and has for an object the provision of a wheel turning device for turning flat or crown surfaces on the peripheries of



WHEEL TURNING DEVICE.

wheels too large to be mounted on a lathe. For the purpose mentioned use is made of a bed provided with a straight track and a curved track, a tool carriage mounted to operate on the tracks, and means for operating the carriage over either of the tracks. The illustration gives a plan view with parts broken away to disclose the carriages operating over the curved track.

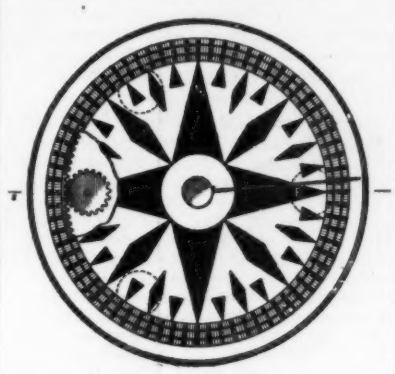
MOTOR CONTROL APPARATUS.—D. WALD, O. C. BRITSCH, and M. TAIGMAN, New York, N. Y. This apparatus may be used in connection with any suitable mechanism, but is especially adapted to be applied to a power sewing machine. The motor control will simultaneously throw the switch with the movement of the control arm, so as to prevent the sparking on the resistance contacts, thus increasing the life of the latter.

SWEEPING MACHINE.—L. B. HOOKER, San Francisco, Cal. The aim in this case is to provide a machine having means by which the rotary brush may be adjusted to any one of a plurality of positions relatively to the frame, with means by which the driving mechanism, supported by the frame, may be quickly adjusted for operating the rotary brush after it has been adjusted.

ELEVATOR.—F. SCHWARZ, Berne, Ind. This elevator has a counter weight, the cage or elevator platform being provided with a windlass adapted to wind a heavy balance chain secured to the counter weight so that the excess weight of the chain may be shifted from the cage or elevator to the counter weight and back again as may be desired.

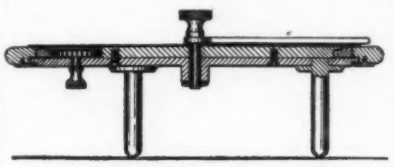
STEAM TRAP.—G. KEISLING, Scranton, Pa. This improvement comprehends particularly a trap having a shifting weight of improved construction arranged in connection with a reservoir for the purpose of facilitating the step of tilting the reservoir and of preventing its return to normal position until all of the water of condensation is discharged, the return of the reservoir then being effected by the restoration of the weight, under control of gravity, to its normal position.

INSTRUMENT FOR USE IN NAVIGATION. OVE B. SANDERS, Key West, Fla. This invention relates to a new and improved instru-



INSTRUMENT FOR USE IN NAVIGATION.

ment for use in navigation, whereby the true course is determined from the compass course in the shortest possible space of time, by mechanically allowing for the deviation and variation. An object of the inventor is to pro-



VERTICAL SECTION OF INSTRUMENT.

vide an instrument with a plurality of relatively adjustable circular graduations whereby the various deviations and variations may be allowed for. The invention is fully illustrated in the accompanying engravings. The large one is a top plan view and the other a vertical section of the line 2—2. It is inexpensive to manufacture, readily accessible, and easily operated.

CHECK CONTROLLED STAMPING MACHINE.—P. LAMBERTI, New York, N. Y. This device on the insertion of the proper amount of change will impress on an article of mail matter a serial number, the hour and date of mailing, the station or box mailed at, and an inscription stating that the required amount of postage has been paid; whereby a great saving in the handling of letters, and the number of clerks necessary to sell stamps, will be accomplished, and further, whereby any pilfering of the postage money or of letters themselves will be immediately detected.

Prime Movers and Their Accessories.

PACKING FOR PISTON RODS.—J. A. BOLCH, New York, N. Y. Among the principal objects in view here are: to provide a packing for piston rods universally contractible to preserve the parallel relation of the bearing surface to the piston rod; and to provide an elongated packing for piston rods constructed from metal and arranged to contract evenly throughout its length upon the rod.

GAS TURBINE.—P. KRAUSE, Babylon, N. Y. This invention relates to certain improvements in turbines and more particularly to that type of turbine in which an explosive mixture is ignited in a separate chamber and admitted to the blades of the turbine. One of the important features is the means employed for controlling the explosive mixture and the deliverance of the same to the blades of the turbine.

INTERNAL COMBUSTION GAS-TURBINE ENGINE.—E. ATWELL, Baltimore, Md. This invention provides an engine wherein the explosive mixture is primarily compressed and exploded while so; provides an explosion chamber wherein is exploded the compressed charge of explosive mixture while establishing communication between the said chamber and the turbine rotor; provides a reciprocating mechanism for compressing and firing the mixture as distinguished from the turbine mechanism; and provides an engine employing in mutual operative relation a reciprocating explosion chamber and a turbine shaft driving rotor.

EXPLOSIVE ENGINE.—W. W. WELLS, Clyde, Ohio. In the present patent the invention is an improvement in multiple-cylinder engines, particularly engines in which the cylinders are arranged in pairs and are co-operative with each other in the introduction of scavenging air preparatory to the admission of the explosive charge.

INTERNAL COMBUSTION ENGINE.—A. M. CLÉMENT, New York, N. Y. This invention provides sliding valves arranged and constructed to avoid leakage of gas due to wear of the sliding parts; provides a simplified construction for valves whereby expansion pressure is relieved therefrom during movement thereof; and provides a valve operating mechanism embodying a single cam and simplified transmission mechanism connected therewith.

ROTARY ENGINE.—HENRY HEYEN, New York, N. Y. This invention refers more particularly to an engine comprising a stator casing, a rotor in the casing, a steam chest, a movable steam duct therein adapted to be arranged in different positions to direct the fluid under pressure into the casing in different directions, and vanes carried by the rotor and adapted to receive the fluid at opposite sides, according to the position of the steam duct.

TRACTION ENGINE.—D. O. DEWITT, Aberdeen, S. D. The objects here are to provide a traction engine which may be operated with a minimum of power, especially over soft ground; to simplify the construction by curtailing parts usually employed in the running gear; to provide facilities for steering and piloting the machine over uneven and soft grounds with freedom, by a single operator, and to dispense with the differential gear used in machines of the class to which the invention belongs.

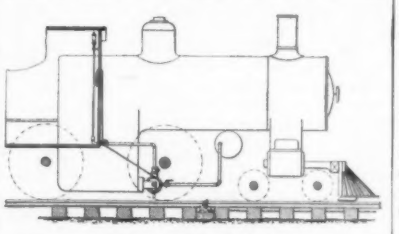
Railways and Their Accessories.

TRACK MOVING MACHINE.—E. L. HAYWARD, Davenport, Iowa. In this patent the invention has reference to improvements in means or apparatus employed in handling steel and ties in track construction. The intention here is to provide means or apparatus for use especially in timber lands, whereby the handling and transportation of track material is facilitated.

METALLIC TIE AND RAIL FASTENING DEVICE.—J. F. ROBINSON, Atlanta, Ga. An object of this inventor is to provide a tie which shall form a resilient bearing surface, thereby absorbing shocks. The tie will prevent the spreading of the rails and the accidents consequent thereto. A spring rail fastening device is provided which holds the rail in fixed position, thereby doing away with the usual method of fastening rails by spikes.

RAILROAD CROSSING.—J. B. DUNLAP, Tulsa, Okla. An object in this instance is to provide a crossing which obviates the usual jars incident to the passage of a train over the crossing. This is accomplished by providing movable track sections, which may be so moved as to complete the track in either direction, so that the tread of the wheels may move on a continuous bearing surface.

OPEN SWITCH SIGNAL.—GEORGE H. RICE, Office Quartermaster's Dept., U. S. Army, Honolulu, Hawaii. This invention has reference to a means of warning an engineer that he is approaching an open switch (about a quarter of a mile off), so that he may be prepared and have his train under perfect control. The object of the invention is to provide a device which will be simple in con-



OPEN SWITCH SIGNAL.

struction, positive in its action, and which will have the fewest parts consistent with accurate working, and which at the same time will be strong and durable. The engraving shows the signal attached to the engine and a tripping mechanism attached to the track. Means provide for making the signal-sounding mechanism inoperative when desired.

CAR WHEEL FLANGE LUBRICATOR.—J. E. FEENEY, Monterey, Mexico. The invention relates to an automatic car wheel lubricator, and provides a device which will positively supply a lubricant to the flanges of the car wheels when they are rounding curves, to prevent friction between the car wheel flanges and the rails, the lubricant being fed instantaneously, and in sufficient quantities.

Pertaining to Recreation.

MOTOR CYCLE TANDEM ATTACHMENT.—W. F. BRACHER, San Jose, Cal. The object of the invention is to provide an attachment by means of which the ordinary single passenger motor cycle may be converted into a two-passenger vehicle with the seats tandem without any changes in the structure of the vehicle itself. The attachment is simple and inexpensive and easily attached and detached. No change is necessary in the construction of the cycle.

TROLLING HOOK.—J. P. TELFORD, Owen Sound, Ontario, Canada. The invention relates generally to trolling hooks for fishing, and the principal purpose is to provide a hook having the spoon or bait revolubly mounted thereon so that when in the water the spoon or bait will be attractive to the fish, the spoon being revolved as the hook is drawn through the water.

TOY.—M. A. BURTHE, University, Va. In this invention the improvement is in toys, and its object is the provision of a simple, cheaply constructed toy, especially designed to afford amusement, while at the same time developing quickness of observation, and dexterity of hand. A net catches the game piece, when the operator fails to properly place the piece, and an opening permits the said piece to be returned readily to the shank.

Pertaining to Vehicles.

WAGON BOX FASTENER.—H. E. BART, Broken Arrow, Okla. The purpose of this improvement is to provide a simple, inexpensive and easily operated device for use in holding the parts of the box together, without injuring the same, which may be quickly applied or removed. The device consists essentially of a pair of telescoping members or bars, each having a clamping jaw at its outer end, co-operating with the jaw of the other member, and a clamp for holding the members in adjusted position.

AUTOMOBILE AIR PUMP.—A. M. CLÉMENT, New York, N. Y. The invention provides a pumping mechanism operatively attached to the driving axle of an automobile for inflating the tires of the wheels not directly connected with the pumping mechanism; provides means for manually operating the pumping mechanism independent of the wheel and power-driving mechanism of the automobile; provides means for utilizing the wheel of the automobile with which the pumping mechanism is connected as a fly wheel for the pump when the same is manually operated; and provides means for rigging a drum on an automobile driving wheel to gyrate about the axle when carried thereby to inflate the tire of the wheel on which it is mounted.

SIGN HOLDING DEVICE.—W. A. RINDGE, 10-22 Ionia Street, Grand Rapids, Mich. In this instance the invention pertains to devices for holding signs, more particularly those that are to be used to display the license number of automobiles. An object is to provide a device by means of which a sign may be held rigidly in position so that there will be no danger of the sign's becoming loose and dropping from the vehicle.

WIND SHIELD.—J. H. SPRAGUE, Norwalk, Ohio. This invention refers to shields adapted for use upon motor vehicles, and more particularly to that type of shield which has a transparent section, movable to operative or inoperative position. One important feature includes the use of rollers within the hinge, and fitting in V-shaped grooves for locking the sections of the shield in predetermined relationship.

TAXIMETER CONTROL.—J. D. SULSONA, New York, N. Y. In this case the invention refers to a new and improved attachment for taxicabs, whereby the taximeter may be controlled so that the chauffeur cannot conveniently operate the taxicab without recording the distance traveled when the taxicab is occupied by a passenger.

SPRING WHEEL.—O. H. HINDS, Le Mars, Iowa. This inventor provides a novel construction of spring wheel in which the lateral rigidity incident to or characteristic of the ordinary automobile wheel will not be impaired and in which springs may be utilized to secure the desired resiliency of the wheel in a radial direction in a simple and efficient manner.

TIRE.—O. H. HINDS, Le Mars, Iowa. In this patent the invention is an improvement in tires and particularly in the means for excluding dust, dirt and the like from the joint between the flanges from the rim and the tire which is movable radially in said flanges, the present application being a division of an application formerly filed by Mr. Hinds.

STEERING WHEEL FOR AUTOVEHICLES.—W. P. FEST, JR., Buffalo, N. Y. The rim of this wheel is divided transversely so that it is formed practically in halves, or nearly equal semicular sections, one of which is fast on the steering shaft and the other hinged and thus adapted to be raised and folded back upon the fixed section so that it will not obstruct the chauffeur in entering and leaving his seat.

VEHICLE WHEEL.—A. BROOKER, Lancaster, Wis. The invention relates to improvements in automobile wheels, and particularly to the tire therefor, whereby an increased durable resiliency is obtained. An object is to provide a tire composed of a plurality of resilient members, preferably of a metallic nature, spaced apart and connected together to form a continuous resilient element.

Designs.

DESIGN FOR A GLASS GOBLET OR SIMILAR ARTICLE.—C. O. NORTHWOOD, White Mills, Pa. In this ornamental design of a glass goblet, the article is of the elongated type of body and stem, the whole set in a somewhat flat stand. The flowers, leaves and tendrils decorating the glass are of peculiar interest and beauty. Mr. Northwood has another design which is very much broader and shorter than the one described, and set upon a very short stem, the ornamental feature being at the rim and extending about one-third down the length of the bowl shaped body.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

THE AEROPLANE. By Claude Grahame-White and Harry Harper. Philadelphia: J. B. Lippincott Company, 1911. 317 pp.; 93 illustrations. Price, $3.50.

Although the title of this book reads "The Aeroplane, Past, Present and Future, by Claude Grahame-White and Harry Harper," only a few articles are to be credited either to Mr. Grahame-White or to Mr. Harper. Just why they should figure as authors, seems somewhat mysterious. As a popular book on aeroplanes, the book is likely to serve a useful purpose, even though there are probably now no less than three or four dozen simply-worded volumes on aeroplanes struggling for existence in the book market. Much practical information is not conveyed. By far the best article in the book is Col. J. H. Capper's discussion of the aeroplane in warfare, a sane presentation of the possibilities and limitations of the flying machine for military purposes. For popular reading, the book can be commended; but for valuable technical information, the reader will find it far too ephemeral.

DIE EXPERIMENTELLE GRUNDLEGUNG DER ATOMISTIK. Von Werner Mecklenburg. Jena: Gustav Fischer, 1910. 140 pp. Price, 250 marks.

The atomic hypothesis has long possessed a double sphere of usefulness. To the chemist it has represented a most convenient picture by means of which to express in simple terms, the "laws of chemical combination." So convenient, indeed, to the chemist, has been the language of the atomic theory, and so generally adopted has its use become, that when Wald pointed out, some years ago, how all the facts of stoichiometry could be accounted for without recourse to this hypothesis, he found himself speaking to a rather unappreciative audience, and would probably have passed almost unnoticed but for the authoritative support lent to him by Ostwald in his Faraday lecture and on other occasions. There seems to be little doubt now that the evidence of chemistry alone would have been insufficient to firmly establish the atomic hypothesis. But, on the other hand, this hypothesis has been of supreme interest to the physicist, firstly, in its relation to the mechanical theory of heat, with its off-shoot, the kinetic theory of gases, of solutions, and latterly, also of suspensions; and secondly, in the development of the electron theory. The evidence which has thus accumulated in favor of the atomic hypothesis is now well nigh irresistibly convincing, so that even Ostwald, formerly so strongly opposed to the atomistic point of view, openly declares himself its adherent, and definitely accepts the atomic constitution of matter as one of the basic starting points of chemical science, in his last edition of his "Outlines of General Chemistry." The author of the book under review may be envied for the extremely grateful task which he has undertaken—that of laying before the reader a concise and yet essentially complete account of a field of physical science, which has from the first possessed features of remarkable interest, but which especially in later years, has brought developments nothing short of spectacular. Have we not today direct optical evidence of particles very little greater in size than the calculated dimensions of an elementary molecule? Particles which, be it said, display all the characteristic properties and phenomena foreseen by the theoretical physicist in his investigations of the nature and behavior of molecules. If the determination on theoretical grounds of the molecular dimensions by the work of Clausius, Maxwell, Boltzmann, impresses us as a triumphal feat of human intellect, the confirmation of their conclusions by direct experiment comes as a crowning testimony, both to the power of that intellect, and to the resources of experimental skill. And if the subject is one of remarkable interest, the author has been equally fortunate in his treatment of it. In the course of four chapters, he lays before the reader in simple terms the main experimental facts and theoretical lines of reasoning upon which the modern structure of the atomic hypothesis is built. The first chapter is headed "The Existence of Discrete Particles in Seemingly Homogenous Solutions;" the second deals with "The Dimensions of the Molecules as Determined by the Kinetic Theory of Gases." The third chapter is devoted to that remarkable phenomena, known for some time, but almost forgotten by the physicist, the Brownian movement, which has quite recently proved such a rich mine of information of the highest importance in the final establishment of the atomic theory upon an experimental basis. The fourth and last chapter deals with another subject the study of which has proved one of the most fertile fields of modern physical research, and has contributed among other things, the very cornerstone of the atomistic point of view.

The author has succeeded in striking a most happy medium between a purely popular presentation on the one hand, which, for lack of detail, would fail to give the reader a true insight into the nature of the very remarkable developments discussed, and, on the other hand, a highly technical treatise, from which only the specialitst could derive any advantage. The book is most highly recommended to all who take an interest in the chemical and physical phenomena to which it refers, and quite especially to those who, having at least some knowledge of the subject, wish to refresh their memories on familiar points, and to bring their acquaintance with a most fascinating province of physics up to date. It is heartily to be wished that translations of this work into English and French may soon appear upon the book market.

A few such errors as unavoidably occur in a first edition have been noted in perusing the book, and may be listed here for the benefit of the reader. On page 22, line six from below, the symbol x has apparently been omitted after the word "Höhe." This might possibly cause some confusion. On page 25, it is stated that a table of molecular dimensions, etc., is appended at the end of the book. In point of fact, this table appears between pages 64 and 65. On page 106, the word "Grammolekülen" should evidently be "Gasmolekülen." These trifling errors do not, of course, in any way detract from the very high value of the book before us.

POWER. By Charles E. Lucke, Ph.D. New York: The Columbia University Press, 1911. 316 pp. Price, $2 net.

In 1910 Prof. Lucke delivered a series of eight lectures on the phases of power. These lectures have now been incorporated in book form in a worthy manner. The titles of the lectures are the following: I. The Relation of Mechanical Power and Machinery to Social Conditions; II. Means Employed for the Substitution of Power for the Labor of Men; III. Essential Elements of Steam-Power Systems; IV. Principles of Efficiency in Steam-Power Systems; V. Processes and Mechanism of the Gas-Power System; VI. Adaptation of Fuels for the Use of Internal Combustion Engines; VII. Water-Power Systems and Basal Hydraulic Processes; VIII. Social and Economic Consequences of the Substitution of Power for Hand Labor. The lectures are all of them written with such clearness that a layman of intelligence ought to be able to understand them.

A POTTERY PRIMER. By W. P. Jervis. New York: The O'Gorman Publishing Company, 1911. 8vo.; 188 pp.; illustrated. Price, $1.

It is not surprising that the art and craft of pottery should appeal strongly to the artistic bent of mind, or that its products should have raised up an enthusiastic army of collectors. Its history appeals to us on many sides. It has associations which bind past and present, foreign and native. It builds up common clay into expressions—often very beautiful expressions—of the higher mind. It is flower-like in its fragility, in its blending of body and spirit. Its symbolism has permeated the literature of the world for countless ages. In "A Pottery Primer" is conveyed to us this dual presentment of body and mind—the terminology, processes and technique of the craft, together with not a little of the grace and eternal freshness that clings to the art. The illustrations place before us examples of ancient treasures and more modern works, and admirably serve the writer's avowed purpose to awaken the reader to a desire for further research. In addition to the plates, cups, and vases which typify succeeding phases of history, we have glimpses of panels, lanterns, fountains, and mantels of distinction. This is really much more than a mere primer, and is a noteworthy addition to Mr. Jervis's earlier works on ceramics, pottery, and pottery marks.

RADIUMNORMALMASSE UND DEREN VERWENDUNG BEI RADIOAKTIVEN MESSUNGEN. By E. Rutherford. Leipzig: Akademische Verlagsgesellschaft m. b. H., 1911.

In the course of the last decade our knowledge of radioactivity has rapidly widened. Not only have the types of radioactive substances which emit radiations been carefully studied, but much labor has been spent in trying to fathom the nature of the complicated processes which occur in radioactive matter. A theory has been proposed which for the time being, explains satisfactorily a great number of phenomena. That theory, which is called the transformation or disintegration theory, was first proposed by Rutherford and Soddy in 1903, and was based upon the supposition that the radioactive atom is unstable, and that it decomposes with explosive violence, at the same time emitting characteristic radiations. As the result of this atomistic explosion, a new atom is produced, quite different from the parent in chemical and physical proportions. These new atoms are also unstable, and give rise to another set of atoms. Thus the process may continue for some time. In investigations of this kind standards of some kind are necessary. This book of Prof. Rutherford's, which is no doubt familiar to many English readers in its original English expresses the necessity for a normal mass of radium and its use in radioactive measurements, a matter which was discussed at the last radiological congress held in September, 1910, in Brussels.

A YEAR IN A COAL-MINE. By Joseph Husband. Boston: Houghton Mifflin Company, 1911. 12mo.; 171 pp. Price, $1.10 net.

Ten days after leaving college a young Harvard man became a laborer in a non-union coal-mine of the Middle West—starting very literally at the bottom with the aim of learning the business thoroughly. The ordinary work and life of the underground city would alone make good reading at the hands of an educated man with a sympathetic knowledge of nature values, but Husband was fortunate enough—or it is our good fortune, if you so prefer it—to experience in that one short year all the thrills that strikes, fires, and explosions are capable of furnishing. The result is a document of some value as a study of mining conditions, and of popular interest in so far as hazardous moments and adventurous days can make it.

UNSOUNDNESS OF MIND. By T. S. Clouston, M.D., LL.D., F.R.S.E. New York: E. P. Dutton & Co., 1911. 8vo.; 360 pp.; 14 illustrations. Price, $2.50 net.

Popular interest has of late years been quickened toward this important subject. Criminals are more and more availing themselves of the plea of insanity in an attempt to escape punishment. We still ridicule the weak-minded and subject the inmates of our insane asylums to unnecessary cruelties; but we are slowly learning that a diseased brain is as much a physiological fact as a diseased liver, and that no odium should attach to its victim. Dr. Clouston handles a most difficult subject in a manner nothing short of masterly. The volume answers, or at least discusses illuminatingly, the most absorbing questions. Since a sane man often appears to act irrationally, and an insane subject frequently presents no irrational thoughts or actions to our view, how may we distinguish between a sound and an unsound mind? If, in infancy, a limb is amputated, the corresponding nerve cells of the motor centers in the brain shrivel up. To what extent have we localized in the brain these various functionings? What proportion of us is really unsound in mind? Are we all a little affected, as the well-known remark of the old Quakeress would lead us to mistrust, or is our universal mind built upon a firm foundation? Dr. Clouston sketches for us eleven orders of brain in their characteristic workings. His conclusions are optimistic, his opposing facts well weighed. The relation of heredity, of nerve exhaustion, of other causes, to unsoundness of mind and insanity, is made wonderfully clear and, not stopping at a mere presentment of the evil, suggestions for preventive and curative regimes are given. The hopeless cases are differentiated from the hopeful, mania from melancholy, the functional difficulties from the organic, and the workings of the brain are bared to the gaze in a way that all can understand. The volume embodies the latest theories and discoveries, and clearly conveys knowledge that no parent, at least, should be without. Its suggestions, if followed, would vastly decrease the world's troubles and result in the improvement of the human race.

ELEMENTARY CHEMISTRY FOR COAL-MINING STUDENTS. By L. T. O'Shea. New York: Longmans, Green & Co., 1911. 8vo.; 319 pp.; illustrated. Price, $1.80 net.

As the name indicates, this book sets forth such simple chemical principles as bear upon the work, the welfare, and the safety of coal miners and the value of their product. The gases found in the air of coal mines can be adequately dealt with only by utilizing a knowledge of chemical action and combination. This touches the problem on its life-saving and property-conserving sides. On the purely economical side of the question, coal itself must be regarded as a combination of carbon, hydrogen, nitrogen, oxygen, etc., and the proportions of these determine its value for particular purposes. Here again chemical analysis is taking a part of growing importance, in that it determines the value of a coal in its application to special uses. Colliery explosions are made the subject of careful study. The book should be cordially received by all who are interested in what it has to offer.

ABROAD WITH THE FLETCHERS. By Jane Felton Sampson. Boston: L. C. Page & Company, 1911. 8vo.; 368 pp.; illustrated. Price, $1.60 net.

"Abroad" has reference to the stereotyped zig-zag from Naples to Rome, Florence, Venice and Milan, through Switzerland and Western Germany, with a dash up into the Netherlands and a descent through Belgium to Paris, thence to London, to Scotland, and back to Liverpool to take the home-going steamer. "The Fletchers" are a quaint old couple of the rural type, through whose eyes all the old familiar sights are seen from a new angle. The sayings of Thomas Jeremiah Fletcher form no small part of the recital, which, showing a 'prentice hand, still atones by a certain freshness and spontaneity for any technical shortcomings. The illustrations are from photographs by the author, and are very clear and good.

HALF HOURS WITH THE SUMMER STARS. By Mary Proctor. Chicago: A. C. McClurg & Co., 1911. 232 pp.; illustrated.

In this little book Miss Proctor has given just the kind of information which the average astronomically-uninformed man desires about the stars. Not only does she give the mythological significance of the more important constellations of stars, but the result of much modern scientific discovery.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12538) T. E. W. says: Would like some information in regard to silvering a speculum for a reflecting telescope. What formula and how to handle it? What curves shall I use in making high and low power eyepieces for a 12-inch reflector of 72-inch focus? A. You will find in the SUPPLEMENT 1671 the process for silvering a speculum clearly and fully described. In SUPPLEMENT 1599 is a full and valuable article giving the data for eyepieces of a good range of focal lengths. We will send these for ten cents each.

(12539) B. F. J. asks: Can you give me any information regarding paper that can be discolored by an electric current? A. There are a number of ways of preparing paper so that an electric current will discolor it. The methods of rapid telegraphy are based on such an action. The simplest is to use a paper which has been wet with a solution of starch and potassium iodide in hot water. The paper turns dark at the positive pole. Another method is to use a solution of sodium sulphate in water mixed with a solution of phenolphthalein in alcohol and water. With this solution the negative pole produces a pink color. This is what is used in the well-known pole tester, which consists of a glass tube, filled with a colorless liquid, with a wire let in at each end. We add that the strength of these solutions may be varied widely with the same result.

(12540) J. M. asks: A curious thing happened in my neighbor's house. One day—it was just before noon—the lamp chimney exploded into small pieces, measuring, the largest, ½ inch down to less than ¼ inch. The lamp was not burning. The explosion made quite a report. Can the SCIENTIFIC AMERICAN tell us what was the cause? A. The lamp chimney which went to pieces so suddenly and completely was strained in rapidly cooling, and probably was strained more in some directions than in others. The strain was finally so great that the glass gave way in the weakest place, and then the whole chimney went into bits. Glass should be annealed very carefully by cooling very slowly to avoid such accidents. Lamp chimneys sometimes break when the lamp is burning, because one part gets much hotter than the others.

(12541) J. M. M. asks: The Nebular Hypothesis assumes the cooling of hot bodies in space. I have been unable to find any explanation consistent with the present theories of heat and of the nature of the ether, as to how such cooling takes place, and what becomes of the heat lost by the cooling body. Obviously, it must either exist in space or be destroyed. We cannot assume its destruction. The assumption that it exists in space in the form of heat waves in the ether leads to difficulties. If this be so, only an infinitesimal portion of the heat lost would ever be picked up by any other body, and the total amount of energy in the material universe is and always has been constantly decreasing—hardly a safe assumption. Nearly everybody knows how greatly the narrow and imperfect vacuum of a thermos bottle retards the radiation of heat. The absolute and limitless vacuum of space must be far more efficient. I shall be greatly obliged if you will clear up my difficulty, or will refer me to some discussion of the questions involved. A. No one can answer the question you ask as to the final disposition of the heat radiated into space constantly by the sun and all the heavenly bodies. It is as unanswerable as that other conundrum, "What becomes of all the pins?" The law of the Conservation of Energy requires us to believe that it is received by other bodies which are colder and is absorbed by them for a time, to be radiated again, and so pursue a ceaseless round of radiation. Your statement as to the thermos bottle is not quite correct. Radiation is not impeded by a vacuum. The little whirling radiometer shows that. A century ago or more, Rumford placed a thermometer in a Torricellium vacuum, such as is found in the barometer, and showed that it was immediately affected by external heat, by immersing the vacuum bulb in hot water. The vacuum in the thermos bottle prevents conduction and convection, the polished surfaces prevent radiation as far as it can be prevented. The thermos bottle thus becomes the best insulator for heat waves which we have. It is a modified Dewar bulb, such as is used for liquid air, made more durable than the usual Dewar bulb. You will find in our SUPPLEMENT 1855, price ten cents, a valuable article upon the "Heat Insulating Efficiency of the Vacuum Jacketed Bottle."

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Artificial Life

(*Concluded from page 272.*)

causes or conditions of development and growth. For the egg cell of many plants or animals is in a resting stage and can begin to develop, or, it can resume its activities, only after fertilization. Quite apart then from the relation to heredity, the process of fertilization must be somehow intimately related to the process of growth, the process of cell-division and those other processes that constitute the life of the organism. To produce articial parthenogenesis is therefore to find the physico-chemical equivalent of a fundamental vital process.

For twenty years experimenters were able to make various physical and chemical agents do the work of the living sperm in causing the egg to begin its development; but the substitute was not quite complete, for the development in every case proceeded only a short way. A fertilized egg begins its development by a division of the nucleus into two halves, which form the centers of two cells. Each of these divides again, making four; these divide into two again, and so on, until (in very many species of animals) there is formed a hollow sphere of one layers of cells (Figs. 4 to 7). At this stage all the cells are practically alike. From this point on there appear various changes and differentiations in development. Most of the earlier experiments in artificial parthenogenesis did not carry the development of the young organism much beyond this stage. In recent years it has been possible to obtain artificially parthenogenetic individuals of sea-urchins and other organisms developed to a much farther stage, in some cases even up to the appearance of the adult form.

The first record of artificial parthenogenesis is that of the Russian zoölogist, Tichomiroff, who in 1886 made the unfertilized eggs of silk worms develop by brushing them gently, or by placing them for a short time in concentrated sulphuric acid. During the following year Dewitz tried to induce development in unfertilized frog's eggs by treating them with corrosive sublimate, and reported successful results. But his experiments were repeated by Wilhelm Roux, who found that what Dewitz took to be early segmentation stages in the unfertilized frog-eggs were merely wrinklings on the surfaces. However, Richard and Oscar Hertwig observed the beginnings of segmentation under the influence of various poisons. In 1898, Kulagin experimenting with the unfertilized eggs of frogs and of fishes, obtained the beginnings of segmentation through the use of diphtheria antitoxin. These results have not been repeated, and their significance is not clear. Prof. Morgan used a variety of salts in the attempt to induce artificial parthenogenesis, and obtained a succession of nuclear divisions, but no true segmentation.

The most elaborate and fundamental experiments in artificial parthenogenesis are those by Prof. Jacques Loeb, begun in 1899. After familiarizing himself with the behavior of sea-urchin eggs under different conditions, and in relation to the sperms of several other marine animals, he began a series of experiments that have served as the basis for practically all subsequent work in this field. His first experiment consisted in raising the osmotic pressure of the water containing unfertilized eggs, by the addition of a quantity of common salt solution, and then returning the eggs to normal sea water. Although the results were different with different species, he obtained positive results with all of them. Yet the development of the eggs was not exactly the same as in the case of eggs normally fertilized.

One difference was that the fertilized eggs always formed a thin but distinct membrane before developing; the fertilized eggs developed much more rapidly than the parthenogenetic eggs; the fertilized eggs developed in about 100 per cent of the cases, whereas with the experimental eggs he obtained at first from 1 to 2 per cent. The larvæ of fertilized eggs had a smooth outline and swam near the surface of the water; the larvæ from the parthenogenetic eggs had a ragged outline—owing to the absence of a membrane—and clung to the bottom of the tanks. (Fig. 3b.) From these differences it was included that the osmotic action of a hyper-tonic solution suffices to initiate not all of the effects of fertilization, but only some.

But later Loeb was able to induce the formation of a membrane in unfertilized eggs by the use of certain organic acids (monobasic acids of the fatty series, such as acetic, butyric, etc.). Now the treatment of these eggs with the hyper-tonic salt solution after the formation of the membrane resulted in the normal development of the sea-urchin eggs up to the so-called "Pluteus" stage. (Fig. 2.) In these the rate of development and the surface-seeking habit were also as in the fertilized eggs.

When others tried to check this work by repeating the experiments in other laboratories, the results were widely divergent. Prof. Loeb himself then showed that these differences were due to the different chemical condition of the sea water at the various biological stations: the degree of alkalinity of the water is an essential factor. While in his earlier experiments he never had more than one egg in five develop, he was able to get 100 per cent after finding the relation of the alkalinity to the beginning of development. By means of an alkaline bath he induced the formation of membranes in the unfertilized eggs of a marine worm (*Polynoë*), and these were then induced to develop into normal larvæ by means of osmotically active solutions; and by varying the concentration of the salt in the sea water, the rate of development could be regulated. By changing the alkalinity of the water, the sperms of star-fish were so modified that they fertilized the eggs of the sea-urchin.

Step by step the results of these and other experiments were analyzed, and Loeb concluded that the first effect of fertilization, or the first essential for the resumption of activity on the part of the egg, is some liquefaction or hydrolysis (or both) of certain substances in the egg. But how this change was brought about was unknown. Hans Winkler thought that the sperm brings into the egg an enzyme or catalyzer; he reported to have caused unfertilized eggs to develop by treating them with an extract from sperms. Dr. Gies, of the College of Physicians and Surgeons (Columbia University) repeated Winkler's experiments and obtained only negative results. Using the unfertilized eggs of fishes, Cremer also had only negative results. Loeb showed that it was neither the addition of a positive catalyzer nor the removal of a negative catalyzer that started the segmentation. After the activity of the resting egg is renewed by either a sperm cell or by some one of the physico-chemical agents—which Morgan compared to a *stimulus*—there is needed something to make the nucleus grow and divide; this second factor Loeb considered to be something that will start the process of oxidation in a certain direction, since it is only through oxidation that nuclear matter could be made out of the reserve nutrients in the egg cell.

Yves Delage obtained results parallel to those of Loeb, producing a membrane on unfertilized sea-urchin eggs by means of acids and the subsequent liquefaction by means of an alkali. Later he was able to combine the action of the two factors in one solution by using tannate of ammonia. With this combination he was able to secure development without the presence of oxygen; his methods for eliminating oxygen, have, however, been criticized. He obtained also similar results with the eggs of starfish.

As a result of some of Loeb's work, the action of the chemicals used in these various experiments was compared to the action of ions, or of electric charges. To test the validity of the assumption that alkalies acted because of the negative ions (—OH) produced when they were dissolved in water, and that acids acted because of the positive ions (+H), Delage arranged an apparatus in which charges of electricity could be sent through the unfertilized eggs. He obtained a varying number of developing eggs as a result of sending first a positive and then a negative charge through the preparation. The following year, however, on repeating his

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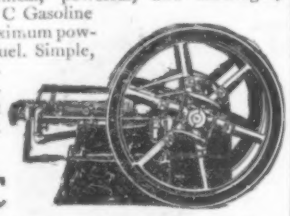

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experiments with improved apparatus, he concluded that neither electric charges nor electric currents have a direct effect in producing artificial parthenogenesis. The development of the unfertilized eggs in his first series of experiments he attributed to the action of acids and alkalies produced in the sea water under the influence of the electric charges. From these results, and from other experiments, in which he induced unfertilized eggs to develop through the use of various neutral chemicals — organic and inorganic — he concluded that the artificial parthenogenesis was always due to some specific chemical action upon some catalyzer, and a physical action upon the surface tension. Delage succeeded for the first time in raising artificially parthenogenetic eggs up to the adult form. Two of the individuals that had developed almost to maturity were both males.

Parthenogenetic development was produced artificially by several investigators both in this country and in Europe, in the eggs of various species of marine worms, echinoderms and molluscs. For example, Prof. Lefevre of the University of Missouri induced normal development of the eggs of the worm *Thalassema mellita* by placing them for a few minutes in dilute acids.

Six years ago Prof. Michael F. Guyer of the University of Cincinnati caused the unfertilized eggs of frogs to develop by injecting into them blood or lymph from adult frogs. Although there was evidence that the white corpuscles carried on (or initiated) some special activities within the eggs, it would now seem that the beginning of segmentation may have been started merely by the pricking of the eggs with the needle of the hypodermic syringe. For a few years later, Dr. E. Bataillon of the University of Dijon made the unfertilized eggs develop by merely stabbing them with a very fine point of glass or metal. There was no introduction of any chemical substance, nor of electrical charge or "polarity" or anything else from the outside. The shock alone seemed to be sufficient in some cases to start the segmentation, but in order to have the process continue there is needed the introduction of a second factor, which he believes to be a catalyzer, or activator. Similar experiments made with the eggs of perch were without results, probably because the temperature of the water was not adjusted to the needs of the animals. Experiments by Bataillon on the eggs of the lamprey eel, using salt water for starting the segmentation, were successful.

Following up Morgan's suggestion that the physico-chemical effect of fertilization and the action of any agent used in artificial parthenogenesis were similar to a "stimulation," Dr. Ralph Lillie set about to find what the common factor was in these cases. He found that in the stimulation of a muscle as well as in the fertilization of an egg the first effect was an increase in the permeability of the protoplasm membrane. Following up this lead McClendon tried various substances that cause the solution of red blood corpuscles and stimulation. In all cases he obtained segmentation of the eggs but these substances had nothing in common from a chemical point of view, except the fact that they increase the permeability of the plasma.

From all the later experiments it is inferred that the first effect of fertilization is the loss of some substances. This may be brought about by changing the permeability of the plasmatic membrane mechanically, chemically, electrically or by change of temperature; and this effect seems to be identical with the first effect in the stimulation of a muscle, or of a sensitive plant, or of a gland. So far this agrees with the conclusions of Loeb. But it is possible that the reason for the beginning of segmentation after the increase in permeability lies in the fact that this change brings about the removal of a substance—perhaps the product of protoplasmic activity—that interferes with further activity. A second stage, in fertilization as well as in stimulation, is accompanied by a change of electric potential at the surface of the egg—perhaps due to the introduction of new ions, in the case of fertilization; this condition may also be brought about artificially by means of mechanical, chemical or electrical agents. Delage's sea-urchins and Bataillon's tadpoles give the most advanced stages in animals developed through artificial parthenogenesis. Whether it is possible to establish a mature generation of animals having only one parent, it is too early to say. Histological examination may show that these animals contain the nuclear framework for only one-half of a normal animal's inheritance—as was found by Morgan to be the case in the non-uncleated egg fragments of sea-urchin in Boveri's experiment, and as was also found to be the case in the larvæ of *Thalassema* raised by Lefevre.

Whatever may be the limits for successfully inducing parthenogenetic development, these investigations must throw considerable light upon the nature of "living matter" and on the problems of heredity.

New York State Barge Canal

(Concluded from page 277.)

paratively low divide in the vicinity of Rome, followed by another continuous descent, to the Hudson. From this it will be seen that there are two critical points in furnishing a water supply for the canal. The problem at the western end is readily solved by the abundance to Lake Erie, but throughout the history of the State canals, the question of supplying the Rome summit level has always presented more difficulties, and has led to the building of a chain of reservoirs among the hills to the south and within the Adirondacks on the north. For the enlarged canal these existing sources are retained, and the two large reservoirs are added.

The work of building the dam and clearing the site at Delta, for impounding the waters of the upper Mohawk, about five miles north of Rome, is now about three-quarters done. Across the greater part of the river gorge, 600 feet wide at its base, the dam has reached its full height of 100 feet above the lowest foundation. When the gaps left for the river and an existing canal are closed, and the top of the dam is extended to its 1,000 feet of length, there will be formed a reservoir some four miles long and two miles wide at the base of its triangular shape, having an average depth of 23 feet and a capacity of about 20,750,000,000 gallons.

The reservoir will be of value in regulating the flow of the stream below the dam. The present low-water flow is from 100 to 150 cubic feet per second, and the maximum flood discharge, of which the record is about 8,200 cubic feet per second. It is estimated that the reservoir will limit all summer floods to a maximum of 2,500 cubic feet and winter floods to about 2,600 cubic feet per second.

Large artificial lakes, built for the supply of navigable canals, are relatively few in number, and, if we ignore partially natural bodies of water, like the Indian River Lake, probably there are not in existence any comparable in size with those projected at Delta and Hinckley for the use of the Barge Canal. However, much larger reservoirs have been constructed for other purposes. The basin at Delta will hold less than one-twentieth part of the capacity of the Salt River reservoir, in Arizona, the largest in the world, and will cover little more than one-third the area of the Ashokan reservoir of the New York city water supply.

Two Latin-American Aviators

THE names of Chavez and Moissant are still household words in Peru and Central America, respectively, though for somewhat different reasons. A writer in the *Deutsche Zeitschrift für Luftschiffahrt* tells of the diverse way in which the career of these martyrs of aviation have impressed themselves upon the imagination of Latin-America.

All Peru takes pride in the heroic and disastrous feat of Chavez. The remains of his aeroplane have been transported to Lima, and placed in a prominent place in the National Museum, in the hall where hang the portraits of the 39 Spanish viceroys, Pizarro and his successors. In the enthusiasm evoked by his transalpine flight an aviation league was founded in Peru, and a Peruvian-born employee of the Blériot works—one

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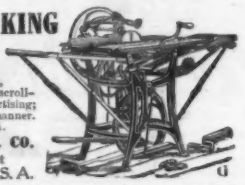

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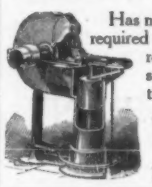

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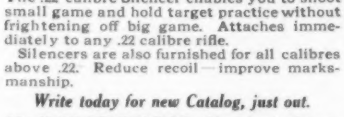

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M. Stoneman

M. Juell

Bielovucic—was imported from France to teach his compatriots how to fly. After several officers had made some progress under his instruction, however, the two aeroplanes imported for this purpose were wrecked. At present the military aviation school and the league, though still in existence, do not boast the possession of an aeroplane. Bielovucic was given a commission in the Peruvian army, and attached to the legation of that country in Paris.

Moissant had a stormy career in Central America before he took to flying. As a self-appointed "admiral" he once commanded the Nicaraguan coasting-steamer "Momotombo," and led a filibustering expedition in Salvador, where he laid many villages in ashes and returned to his ship unscathed. The intervention of the United States government finally forced him into exile in France, where he found a congenial field for his adventurous zeal in the study of aviation. Before leaving America he addressed a letter to the Salvadoreans, in which he declared that he should one day return in an airship and drop bombs upon their capital. When rumors of his achievements in aeronautics began to find their way to Salvador the inhabitants of that country were filled with misgivings; and these have not been altogether quieted by his untimely death in New Orleans. Popular report has it that he was not killed in the accident, and is even now secretly maturing the consummation of his dire threat of long ago.

The Current Supplement

A GOOD example of modern methods of the mechanical handling of materials on a large scale is described and illustrated in our current SUPPLEMENT, which shows on its front page a continuous unloader at work on the territory of the Western Pacific Railroad of California.—Sir William Ramsay in his recent presidential address before the British Association, dealt mainly with the chemical elements and the problems which arise in connection with their inter-relation. No one is better qualified to speak on this subject than the great English chemist, and an abridged report of his address is presented to our readers.—The Effect of Tobacco Smoke on plants is of interest both from a scientific point of view and in connection with indoor plants. Careful observation has shown that this effect is far from negligible. An illustrated presentation of the subject forms one of the articles in this issue. An enormous amount of wood is annually going to waste in the long-leaf pine forests. Dr. Heber has recently made a demonstration showing that from one cord of such wood from 12 to 16 gallons of turpentine can be recovered. One of the phases of telephone engineering work is the proper management and laying-out of the complicated network of cables for an extensive territory. Some of the problems that arise in this connection are most lucidly discussed by F. P. Valentine, in an article whose first instalment appears in the current SUPPLEMENT.—In a copiously illustrated article the principle and construction of the gyro compass are expounded.—Prof. Turner's article on the Great Star Map reaches its fourth instalment, which is devoted to "star positions."—We have become accustomed to look upon the Montgolfier balloon as a thing of purely historical interest. It is interesting to read that of late there have been efforts made to improve this primitive airship and turn it into a balloon for practical use.—It is well known that owing to the defect of capacity a telephone cable tends to distort the waves applied to it at the speaking end. To overcome this, so-called loading coils, having a suitable self-induction, are inserted at intervals along the cable. This very important subject is discussed by the eminent electrical engineer and wireless expert, Prof. J. A. Fleming.—A German writer in *Prometheus* voices some decidedly pessimistic forebodings in regard to the future of the Panama Canal. While we may not follow him in all points, his discussion makes most interesting reading and should be perused by all.—A concise review of the power situation at Niagara Falls is reproduced from the Engineering Supplement of the *London Times*.

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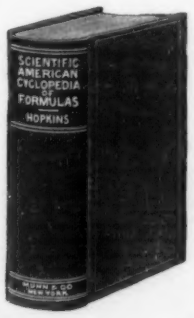

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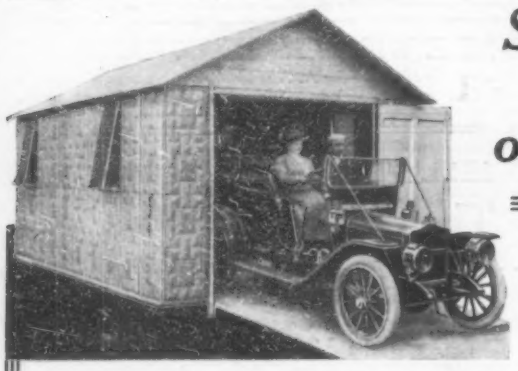

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